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T. A. RICKARD, - - - - Editor

SECRETARY PAYNE, of the Interior Department, has announced that plans are afoot for the greater development of Alaskan resources "through policies that will attract new capital and improve transportation connections with the United States". It is proposed to consolidate the two American shipping lines now serving Alaskan ports and likewise to consolidate the Federal supervision of Alaskan affairs, both proposals being expected to conduce to economy and efficiency.

PREPARATIONS are complete to start removing 20 million tons of worthless overburden that will permit the mining of 5 million tons of rich copper ore in the mine of the United Verde Copper Company at Jerome. The work will be done by steam-shovel, this plan being resorted to after repeated attempts to remove the burning sulphides in the 'fire-stopes' by other methods. Fire first started in the sulphide ore in 1894 and has been burning in certain parts of the mine ever since in spite of efforts to extinguish it by means of steam, water, and carbon dioxide. The project includes the building of a new town adjoining the present site of Jerome, on the 'made' ground that will result from filling the gulch below with waste-rock excavated from the mountainside.

TIN MINING in Cornwall is facing a crisis. Two of the largest companies, Grenville and Dolcoath, are reported to have given provisional notice to 1000 of their employees that operations will be suspended immediately unless definite promise of assistance from the Government be forthcoming, or until the market and operating conditions alter materially. At the present quotation, which is around £270 per ton, the mines are losing money. The operators take the attitude that government regulation during the War reduced by some £500,000 the profits that would have accrued in an open market, and on this contention the plea for a government subsidy is based. Cornwall was the training-school for many of the miners who helped develop the industry in our own country and Dolcoath is one of the most remarkable of the old mines. From its upper levels it produced £1,250,000 in copper ore prior to 1787. The copper was then exhausted, but on sinking deeper tin ore was developed, from which £3,572,179 was realized. At a depth of 3000 feet the tin content of the ore became too low for profitable mining, but lateral work has opened other veins the exploitation of which is expected to produce dividends if the price of tin is maintained consistently in the neighborhood of £325.

BELATED discovery of previously unsuspected wealth has more than once brought admirers, flatterers, and ready favor where none had been before. Even in Nevada where the people pride themselves on measuring a man's worth by what he is, not what he has, this trait of human frailty is being displayed. There is, it seems, a stray wedge of land in the north-east section of Township 13 N., Range 34 E., Mt. Diablo Base and Meridian, a forlorn outcast that until lately had never been given more than a passing thought by anyone. Recently three counties, Churchill, Mineral, and Nye, suddenly developed an affectionate regard for the erstwhile friendless vagabond, and now are competing with each other to establish the closest kinship. Moreover each county brazenly concedes that its earnest solicitude is occasioned simply and solely by recent developments in the mine of the Broken Hills Silver Corporation whose property happens to be situated in the disputed area. Within a short time high-grade silver ore has netted $60,000, and $100,000 worth of ore is said to be blocked out in workings only 150 feet deep. In view of the taxes which will accrue to the county that wins, if the mine develops into the bonanza it promises, it is easy to sense the deeply sympathetic attitude of the contending counties.

MR. JAMES MacNAUGHTON, general manager for the Calumet & Hecla company, is quoted as saying, in effect, that if it were certain that conditions in the copper industry of Michigan would continue as they are today most of the mines in the district would suspend operations immediately. Ahmeek, Isle Royale, and some of the conglomerate-lode enterprises are exceptions to the general rule; they are returning a small profit. But there is little immediate comfort in the situation except the fact that the physical condition of the mines is not essentially changed. There is plenty of 'rock' of a grade that has been profitably treated in years past, and there is a prevailing optimism that sees a readjustment not far in the future that will enable the mines again to be operated on a profitable basis. Some of the factors that have helped put the Michigan companies in this unfavorable position are shared equally by all of the copper producers, but in some respects they have fared worse than their friends in the Western States. The proximity of

the automobile-manufacturing districts with their highly-paid jobs has made it possible for the miner to get lucrative and agreeable employment with little difficulty. These high wages have attracted the best miners and have made it difficult to maintain a reasonable degree of individual efficiency among the men who remained at the mines. Another handicap which is being felt more than ever is the dependence in a large measure upon steam for prime motive power, and the unusual amount of hoisting and hauling of large quantities of low-grade material. The copper companies burn annually more than a million tons of coal, so that an increase of $5 in the price per ton at once adds $5,000,000 to the operating costs. The stock of Calumet & Hecla, that has often sold for $1000 and has paid its holders 152 millions in dividends, is now quoted at $320 per share, the lowest level reached in 40 years. A dividend of $5 recently posted came out of surplus, while the Quincy company, always reputed as being one of the reliable dividend payers, has just found it advisable to pass its regular payment. Nevertheless Quincy is completing the erection of the largest hoisting engine in existence. It weighs, complete, 900 tons and it is designed to hoist ore from a sloping depth of 12,500 feet. The other companies are going ahead too; they have confidence in the future. They feel sure that the price of copper will go up and that the cost of production will come down; that it will be possible again to make a profit from ore that contains only a little more than one per cent copper.

DISCUSSION on the status of silver has almost pushed the gold problem to one side, for the moment. We take pleasure in publishing a letter from Mr. Charles Butters, who needs no introduction. It will be noted that Mr. Butters was uncertain whether his letter ought to be published; that adds to the interest of it, for communications that are so frank as to verge upon indiscretion are just the ones most of us like to read. Mr. Butters, of course, writes as the owner of silver mines in Mexico; his study of the subject is prompted by enlightened self-interest, to which none can take objection. He makes a plea for the greater use of silver, insisting that the countries of Europe have almost abandoned the use of the metal, and hope that we shall be driven to do likewise. Among the Mexicans there is a great and insistent demand for silver coins, and we can fill that demand to our advantage, and theirs, if we awaken to the opportunity. American silver coins are welcome in South America also, and in the Orient, for the world is nearly bare of white money. Mr. Butters proposes to pay his current obligations, to tradesmen and others, in silver; he would like the silver-mining companies to pay their dividends in units of their own metallic product. It is a pious idea, but we anticipate that those receiving silver dollars would deposit them in the bank, preferring to use checks or Federal Reserve bank-notes. Something may be done with the peoples among whom the credit system has been undeveloped, but those used to the exchange of notes do not care to fill their pockets or their safes with the heavy discs of the Mint. Indeed in a perfect world all settlements would be made by exchange of I. O. U.s; it is only in a world rendered imperfect by folly, hysteria, and dishonesty that a hard basis of metal is requisite. At this time when the folly, hysteria, and dishonesty of mankind, as individuals and as nations, are particularly in evidence we find the need for something safer than a signed paper, and that is why we are so anxious to enlarge our metallic base, which is the shock-absorber of our commerce.

THE Exploration Company, which acts as the agent, in London, of the Treadwell group of mining companies, has issued a circular summarizing the position of these companies at the end of the financial year. The information is taken directly from the reports of Mr. F. W. Bradley, who is president of the three companies operating on Douglas island, Alaska. The premier enterprise, the Alaska Treadwell, made a profit of $17,500 from commercial business and interest on investments. A surplus of nearly $2,000,000 of assets over liabilities, exclusive of property and plant, places the company in a strong position to carry out its policy of acquiring new mines in Alaska, thereby establishing the continuity of the enterprise. The Alaska United shows a deficit of $78,900, the operation of the Ready Bullion mine, which is the only one not drowned by the caving at the surface, having been rendered unprofitable by the excessive cost. Mr. Bradley suggests that two courses are open, either to suspend work "until after the purchasing power of gold becomes greater", or to gouge the mine as quickly as possible. He recommends, and the directors have approved, the second plan of action. The Alaska Mexican, which is flooded, made a loss of $21,250. It has realizable assets worth $177,900. Working options on three gold and silver properties in Alaska have been secured, and examinations are being made. It is sad to contemplate the condition of this famous group of mines, and it is much to be hoped that their good tradition will be perpetuated by the transfer of their remaining capital to some new and promising venture in Alaska.

'CHLORIDE VOLATILIZATION' has been successfully applied in the treatment of low-grade copper ore by the Pope-Shenon Mining Co. at its property near Salmon, Idaho. Two comparatively simple operations are involved in the treatment by which the metal in the oxidized ore is recovered in the form of high-grade bullion. The process, developed by Dr. Robert H. Bradford, consulting metallurgist for the company, is a departure from the ordinary methods of smelting. The ground ore, mixed with pulverized calcium chloride in proper proportion, is treated in an oil-fired revolving roaster in which the metal is volatilized and driven off as a fume of copper chloride. The fume is passed through a Cottrell electric treater that functions perfectly in separating the precipitated particles of copper chloride from the gaseous constituents of the smoke. The dust is collected, mixed with lime and charcoal, and fused in a

melting-furnace in which oil is likewise used as the fuel. The molten copper is tapped into bullion-molds as a marketable product, while the slag, which is impure calcium chloride, is crushed and reverted to the original roaster to supply the chloride for subsequent operations. Several features of the process appeal to the metallurgist. The only raw materials required are charcoal and lime, in addition to the necessary fuel-oil. A unit as small as 50 tons is economically practicable; the machinery is not complicated; and the success of neither the roasting nor the fusion depends upon delicate chemical reaction or precise regulation of temperature. Sufficient bullion has been made to demonstrate the success of the process, but the most advantageous mixtures of material and exact degree of roasting for the best results are yet to be determined. The satisfactory performance of the new plant emphasizes the possibilities in combining the operations of modern metallurgy in novel ways and is a credit to the ingenuity and resource of Dr. Bradford.

Americanization

Last week we discussed immigration, and the proposal to restrict, if not to stop entirely, the entry of foreigners. During the decade from 1909 to 1918 inclusive there were admitted into the United States 6,958,034 immigrants, of whom 21% could neither read nor write. In 1910 half of those living in California were foreign-born or the children of the foreign-born. Here admittedly are hard nuts to crack, or, shall we say, tough morsels to digest. Those who oppose the placing of an embargo on immigration as being contrary to the American idea, and as being, in large measure, the shirking of a national responsibility, are compelled to face the duty of making the best of the foreign elements in our population; in short, they advocate systematic Americanization.

Americanization is the making of Americans; that is the bringing of men and women into sympathy with the ideals of the American republic. As those born in this country are Americans in fact, the term Americanization implies the conversion of aliens into American citizens. To do this effectively it is necessary to employ two processes, education and naturalization. The latter process, which is a legal formality, is of no avail in making an alien into a real American citizen unless he has been so educated as to understand and love the traditions and ideas that have made a nation out of the diverse population living in the United States. This nation consists of men and women who themselves or whose progenitors came from foreign countries. They have become united and assimilated by sharing the same experiences; they have fought for their freedom; they have battled among themselves over great principles; they have developed their own ideas of liberty, of law, and of government; they have been fused, by living and working together, by sorrowing and rejoicing together, by thinking and dreaming together, into one nation, separate from any other and unlike any other. This unlikeness is the essence of Americanism, to it the people of the United States owe their identity, upon it they base their ways of living, that is, their civilization. In order to maintain and develop this civilization, this American way of living, with all that it connotes in the conduct of domestic, civic, and national affairs, it is imperative that the incoming foreigner—the immigrant—shall not remain an outsider, alien to the spirit of the country. As Roosevelt said, this must not be "a polyglot boarding-house"; it must be a home in which all those under the same roof shall understand each other and work together in harmony for the good of all. Therefore the newcomer must be taught the habits and imbued with the aspirations of the American citizen. First of all, he must learn our language, for without that no complete understanding is possible; next, he must acquire some knowledge of the history of the country, so that he may appreciate its past; then he must become reasonably well informed concerning the constitution, laws, and system of government under which he expects to live. The success of this educative process will depend not only upon him, but also upon those who undertake to teach him. There must be mutual sympathy. The foreigner must want to become Americanized and we must make it evident to him that we desire to help him to his graduation as a citizen. In short, Americanization is a sympathetic process whereby the foreigner, ceasing to be an alien, becomes a fellow citizen with the direct inheritors of the American tradition.

The foregoing is, we believe, a fair statement of a subject that is vital to the welfare of this republic. Emphasis must be placed upon the need for sympathetic contact with the alien. This means neighborly intercourse between American men and women on the one side and foreign men and women on the other. The children, if let alone, will follow the instinctive sociability of unsophisticated youth. Colonies of alien people should be disintegrated, not by force, but by kindness, through the establishment of American social settlements intended to win the goodwill and understanding of those about them, by mingling with them unaffectedly and naturally. They will have to overcome the opposition of political bosses, bigots, labor contractors, and hyphenated bankers, all of whom profit from the social detachment of whole groups or even communities of foreigners. To be effective in this work of Americanization the social worker must learn the language of those whom he desires to befriend. Undigested alien communities are a menace to the health of our body politic; they must be assimilated by kindness if we are to escape chronic political dyspepsia. It is a condition that confronts us, not an economic theory. The War and its aftermath have greatly aggravated the harmfulness of the un-Americanized elements in our population, because the War made calls upon the devotion of the Europeans in our midst and those calls were not all in accord with the national purpose as it was finally defined by our own participation in the conflict. Since hostilities were formally stopped by the Armistice we have been plagued by various propaganda in favor of different European peoples, all tending to elicit sympathy with one or another of them, and thereby superimpose some sort of European sentiment on top of American patriotism. A German, an Irish, a British, or any other propa-

ganda that draws the citizen away from his proper allegiance to the United States by developing an un-American point of view on matters of national concern is more than objectionable, it is pestilential. Dislike of it necessitates neither a frothy provincialism nor a sloppy internationalism. All appeals for, or against, any propaganda based upon European sentiment have a disintegrating effect on the national spirit, because they serve to accentuate prejudices that are non-American. If the alien elements in this country are to be Americanized, it must be done by developing sympathy with American ideals and not by making calls upon an allegiance that has been surrendered to the United States. Hearst's campaign, for example, may make people anti-British or pro-British, but it does not help in the least—on the contrary, it hinders—the Americanization not of the British alone, but of the Germans or Irish or any others to whom his propaganda makes any sort of appeal. Most Americans object to the repeated compulsion to align themselves for or against such schemes, which serve merely as an irritant entirely subversive of the sincere effort to cause the diverse European elements to forget their origins in the warmth of their allegiance to the country of their adoption. Americanization assumes the existence of a genuine Americanism, which, while not lacking intelligent sympathy with other countries and desiring friendly intercourse with them, is determined to follow its own ideals and achieve its own destiny.

A Code of Ethics

A special committee of the American Society of Mechanical Engineers has prepared a tentative draft of a 'Code of Ethics', which it is proposed to submit for approval to all of the national engineering organizations, with the hope that, if generally adopted, it may become a universal code recognized by engineers in all branches of the profession. The 14 articles of the proposed code were published in our issue of June 19. To some it may seem futile to attempt to improve upon the familiar set of ten admonitions that were first promulgated on Mt. Sinai, and equally so to attempt to legislate morals into people either by imperial or democratic edict. Yet, if a formal code of ethics we must have, let it be brief and to the point. We venture the opinion that some of the articles proposed by the Mechanical Engineers are of too little importance and that some are either inconsistent or not clearly expressed. If they be deleted or revised the essential parts will gain emphasis, and the value of the entire code will be increased. For example, Article 8 reads: "He should satisfy himself before taking over the work of another consulting engineer that good and sufficient reasons exist for the change". There can be but one "good and sufficient reason" for a change other than the voluntary resignation of the first engineer himself. That reason is the dissatisfaction of the client who is presumably the man that foots the bills. Few mining engineers would care to continue in the capacity of consultant to a company that wanted to get rid of them, but that was unable to do so because ethics, or etiquette, would prevent another engineer from taking up the work. Why engineer No. 2 should pass judgment on the motives of the employer or client in seeking the services of another consultant is hard to see, either from an ethical, or from any other codie viewpoint. Article 9 declares that "He must base all reports and expert testimony on facts or upon theories founded only on sound engineering principles and experience". In the name of common sense on what else could an intelligent man base his expert opinion? Indeed, we must assume that all engineers have intelligence; and even if some lack it, the mere fact does not make them guilty of any breach of ethics. Certainly we cannot declare 'unethical', or heretical, one group of engineers because their conclusions based on the identical set of facts diverge widely from those of another group. Judged by that standard every lawsuit involving expert testimony from engineers would produce material for the consideration of the proposed Standing Committee on Professional Conduct. Article 10 reads: "He must not regard as his own any information which is not common knowledge or public property, but which he obtained confidentially from his client or while engaged as an employee. He is, however, justified in using such data or information in his own private practice as forming part of his professional experience." These two ideas are perhaps not flatly contradictory, but they read as if they were. If they mean anything it is that an engineer should not publish confidential information obtained during the performance of his professional duty without the consent of his client. Next is Article 11, which says "He should do everything within his power to prevent sensational, exaggerated, or unwarranted statements about engineering work being made through the public press. First descriptions of new inventions, processes, etc., for publication should be furnished only to the engineering societies or to the technical press." In view of the proclivity of the "public press", which presumably refers to the daily newspapers, to gather sensational and exaggerated, if not unwarranted, statements, the engineer who fulfilled the letter of this mandate would have little time for his professional work. As to the second injunction, the impress of a spirit kindred to our own is manifest. We appreciate the motive, and are duly grateful; but is there any essential obligation for the engineer to do either of these things in order to be 'ethical'? Would the failure on his part to do either be a reasonable excuse for disciplinary action on the part of the national engineering society to which he happened to belong? We mention these things simply to illustrate the point that there has not been exercised enough care and discrimination in the preparation of what is expected to be an enduring code. The various societies may well formulate a statement of essential principles governing the professional conduct of their members, but they should take time to decide just exactly what those principles should be. The Decalogue was written on stone.

Concerning Silver

The Editor:

Sir—On account of the shortage of silver coin in France and Germany and England, travelers going abroad well supplied with silver coins find their way made easy. An American 25c.-piece represents something like two francs, a 10c.-piece would be very welcome money, being about the size of a 50-centime piece. American banking agencies in Paris would find a profitable business in shipping American coinage for their customers. We do thousands of dollars worth of business weekly here at our mines in Mexico with American money. A Mexican silver coin is a great rarity. This has all happened within a couple of years. This change has happened so rapidly that in the State of Sonora all prices are now quoted in American dollars instead of Mexican pesos. They call them "do-lars" and are very fond of them. They look pretty good beside a Carranza bill, 100 to the ?. It would seem good business for the American mints to take any kind of fine-silver bars presented to them and return American silver coins worth per ounce anywhere from $1.29 to $1.38 for subsidiary coins and make this coin by taking in bars at $1 per ounce on any market-price below the coinage-value. Our mints could afford to run 24 hours per day on such business.

The silver producer could surely afford to pay the mint charge, if any, and the express charges, and instead of sending out checks send real newly minted silver coin. People would soon realize that there was such a thing as a silver industry if they saw the real stuff come pouring into the channels of trade, piling up in the safes, like the old days of California. A new interest would be taken in silver mining by the very sight of the bright new money going from hand to hand; a greater tendency to save would be instilled by the sight and ownership of coin as against paper or checks. Many a man would think twice before he counted out and parted with ten thousand new bright silver dollars in ten bags of a thousand each. The bulk appeal of ten bags of bright coin is much greater than that of a cheque with "Ten Thousand Dollars" written upon it.

We talk of interesting people in silver mining by telling how much profit they can make. Profit can be made in rubber, bricks, automobiles, steel, hats, shoes, baking companies, street-car companies, etc., but that is not silver mining. Interest them in the metal itself. How many shareholders in a silver mine paying dividends ever see any of the company's product fresh from the Mint—new bright clean coin? Your own money straight from your own mines—great business! Does not every automobile dealer get a big window on the principal street and gloat over his bright new shiny car, which, the minute it has been sold and once around the block, $1000 comes off its value. While our bright new silver may lose its gloss in going from hand to hand, it still holds its value, good stuff to own; get some, put it away in a safe deposit, always handy. Just about $5 apiece all around would be as much as the great Government storage before the War. That storage is much safer, much more useful, and much more liable to be a source of political safety for the people in time of trouble, in their own pockets than in any great tempting pile represented by floating paper.

How many officers of a silver mining company ever see an ounce of their product? As a rule, none of the home officers, boards of directors, or secretaries. How many of the officers at the mine? Probably one or two—the melter and the local secretary. How many of the miners or mill-hands, or town's-people where the silver is produced? Probably very few. How many silver dollars does the average shareholder of the Nipissing Silver Mines Co., of which there are 14,000 in America and Canada, carry about with him? I will venture to state you could not find 500 single American dollars on the lot. You will find some paper money and subsidiary coin made at a price of about $1.38 an ounce out of silver for which the Nipissing received about 60 cents an ounce. What is the matter with giving these 14,000 shareholders their two million silver dollars in 14,000 packages marked 'Nipissing Silver'? Why, say, they would never want to spend one of them. It would be the greatest advertisement the silver-mining industry could possibly have, every shareholder receiving from a hundred to three hundred new dollars. Where is your imagination if you cannot see the instantaneous effect of every silver-mining company paying out all its production in dollars, or halves or quarters or dimes if you want them, instead of offering bars like merchandise to people who are doing their best to knock their product. Everyone knows that if you have a $20 gold-piece and don't change it you have always got $20. Just change that $20 gold-piece into 50c.-pieces and 10c.-pieces and walk down the pike with your girl—you will not find it intact after one turn; in fact, you can't for the life of you square your account, try as hard as you can. Now, why do the producers decline to put their product into such small pieces that it scatters itself without effort? It will cost some trouble and about 2% of its value, but there can be no such thing as a point of saturation because you can always buy both supplies and labor with American silver coin and your

shareholders will never send your dividend package back and demand gold; so why don't we adopt this plan? Let someone tell me why. Why? Because bankers and financiers can make more money out of the people's money by handling it for them. They can do as much with a little coin and a lot of paper as the individuals can with all coin. This process has been going on so long and so cleverly that most of the world at the present time sees absolutely no gold and they are getting it down so fine that shortly there will be no use for silver—paper, copper, nickel, and nickel and silver taking the place. This is not good for either the public or the gold or silver producer.

A gold miner is supposed to be doing what I have outlined above, paying out for everything in his own product, but as a matter of fact, while he used to do this, he does it no longer. He is now using paper and his single dollar is stretched to about twenty dollars in paper credit. For this he gets no benefit. If everyone should demand gold payment in actual coin you would soon see the price of paper fall and the gold producer would come into his own. Formerly in California the gold miner did pay in gold coin. It would not suit the banker or financier to see actual silver used and demanded in place of paper, because he could not make two into one. He would have to produce the coin for payments. The silver miner wants silver to circulate as coin everywhere and not see shinplasters and postage-stamps take its place. The producer is the one to start it again. Do you suppose if the copper producer could pay in kind as easily as a silver produceer that he would ever try to force his bulk production on a world that can't pay for it in gold? No, he would keep on paying in kind just as the gold miner is actually supposed to be doing. Why, the lead miners, zinc miners, or producers of any kind, would never quit if they could do what the gold miner does. There is only one other who can do that—pay in kind—and that is the silver miner, who paid in kind in a rich and prosperous Mexico for three huundred years, and this was only stopped by absolute destruction of the public mints so that the gold standard could be established in order that bankers could enrich themselves by issuing paper, and finally between the bankers and the public officials the people of Mexico have been absolutely robbed of all their metallic wealth and the credit of Mexico absolutely ruined. I say the metallic money is safest in the hands of the people. No country can be ruined by scheming officials if its people hold the actual coin.

The logical conclusion of such a plan would mean that every convenience should be given to the silver miner for coinage and we should have local mints as they formerly had them in Mexico. For instance, every State producing large amounts of silver, like Montana, Colorado, Nevada, should have a local mint for silver coin only. Imagine Anaconda paying out its total silver production in wages and for supplies, because, as silver is only a by-product, no doubt that these two items would absorb their production of about ten million ounces of silver. Nevada would become an exporter of silver coin; Colorado also. Carry this plan out and the United States would soon realize that there was a real silver industry and she was a leader in this industry. There is a world of sentiment in this idea of actually seeing, having, owning, and handling masses of silver coin. This sentiment, which could be so easily aroused, is at present absent from this silver question. We deal only in figures and hide our bullion in safes and banks. Silver is such a rarity that even the transfer of a truck-load of bars always attracts crowds. Coin the bars, that's what I say, and distribute instead of hiding them away and hunting a customer for an article we produce but refuse to use ourselves, preferring to let other people carry the silver and we our paper. The West will wake up some day and find the East the real bankers of the world, because they are, and have been, accumulating real money—gold and silver. I hope these notes will not be misunderstood as having connection with the free coinage of silver. All we ask the Mint to do is to convert our bullion at the market-price into silver coin. If they will do this, and it surely would be a profitable business, I should like to know from Mr. Baker how much his present coinage capacity is on a 24-hour basis with fine bars. The refining capacity of the United States is ample. Next, what is the coining capacity? Is there any valid reason that would prevent the Mint from doing this business? If such a reason exists the producers should see, too, that such a reason should be promptly removed. It may be doubtful whether this scheme should be published, as it might arouse powerful enemies, whom such a plan would not suit at all. I am not sure of this, however. You would gain friends as well as enemies.

CHARLES BUTTERS.

Copala, Sinaloa, Mexico, May 31.

[We comment upon this interesting letter on another page of this issue.—EDITOR.]

Combinations of Gold

The Editor:

Sir—On page 103 of the 'Mining Engineers' Handbook' in the paragraph entitled 'Gold-Bearing Minerals', I find the following statement: "In some of these minerals, when the ores are refractory, it may exist as an involved telluride, or as a bismuth compound (Richard Pearce)."

Having frequently seen in print the statement that tellurium is the only element with which gold is found in chemical combination, the sentence quoted appears to me as unusual. The question is of particular interest to me as our ores carry a percentage of bismuth as well as gold. It appears to be also a subject of some general scientific as well as economic interest.

J. H. MOCKETT JR.

Red Cliff, Colorado, June 14.

[Gold is found in combination with selenium as a selenide, with silver as electrum, with mercury as amalgam, with rhodium as rhodite, with palladium as an undetermined mineral. The combination with bismuth was found in Australia and is called maldonite.—EDITOR].

REFUGEES ON THE ROAD

A TRAINLOAD OF REVOLTOSOS

The Mexican Revolution

By An Occasional Correspondent

Within two months Carranza has fallen, just when he was least expected to do so. Long ago in 1915, even just after the destruction of Villa's army in the Celaya campaign, everyone was saying "Carranza can't last six months". And even more confident of speedy disaster for the Mexican "scourge of God" were the prophets of 1916 as they saw rapidly pass into history the typhus epidemic, the wholesale repudiation of Carranza money, the Carrizal massacre, and the looting of the State banks of issue. Yet undismayed by these Mexican Cassandras, Carranza proceeds in 1917 to boldly launch a brand new constitution and to exchange his uncertain post of 'First Chief' for the dignified office of national dictator or 'President'.

Carranza was never popular in Central and Southern Mexico, for he had treated this most densely populated part of the country like a conquered province ever since his triumphant entry into Mexico City from the north in August 1914. His general unpopularity in part accounts for his inability to pacify the country and suppress the countless rebel or bandit leaders who under various designations as Zapatistas, Villistas, Felicistas, etc., kept up a constant turmoil in all the rural districts sufficiently fertile to be self-sustaining for their troops. Even to guard the cities and railways, Carranza has had to maintain an army of 150,000 men, the most expensive one in Mexican history, involving in 1917, even, an expenditure nearly thrice what Huerta's army, of a similar size, had cost. As Carranza paid them about the same wages as Huerta, and Mexican soldiers feed themselves, the difference cannot be explained by the extra price for the limited quantity of munitions consumed, but only by graft on a colossal scale.

Carranza's leadership of his party was always analogous to that of a cowboy whose pony has managed to keep in advance of a stampeding herd of cattle, and his attempt to suppress graft well illustrates this. In 1917, as an aftermath of the Mexican-American Peace Conference, Carranza engaged Henry Bruère of New York to visit Mexico and revise his financial accounting system. One of the principal changes due to Bruère's advice was the organization of a general purchasing agency for the army called Departamento de Establecimientos Fabriles y Aprovisionamiento Militar, which was not under the War Ministry but directly under the control of the President himself. Anyone selling merchandise to this new department had to furnish his bill in sextuplicate, so that it had to be approved by six separate officials before a warrant could be issued for payment. When this excellent system had been guaranted a sincere trial by the naming of a (relatively) honest officer, General Murguia, as head of the department, it really seemed as if the days of wholesale military graft were numbered. And so they would have been, had not Carranza harkened to the pleas of his favorite generals, like Juan Barragan, the "Mexican Adonis" and Chief of Staff, and allowed them to continue to make their own purchases as heretofore.

Thus, in spite of an increase in Federal and local taxation of three to eight times the rates prevalent under Porfirio Diaz, the Carranza regime was always hard up. It had no money to construct new streets or public edifices, or even to repair those already in existence. The minor bureaucracy had usually to accept part of its wages in bonds, while the pay of school-teachers was often in arrears and numerous schools were closed entirely for lack of funds. The few big cities were crowded, but not from normal growth, for their surplus population represented the refugees who had fled from the chronic disorder of their rural homes. All Mexico seemed slipping back into the barbarism of the early nineteenth century. The flow of foreign capital for investment had practically stopped in 1914, for who would risk more money in a country where vast sums previously planted had already been jeopardized, rendered unproductive, and even wiped out completely by brigandage on the one

hand and an unscrupulous anti-foreign government on the other.

Such in brief was the situation last summer when candidacies for the presidency began to be launched. Carranza's term ran until December 31, 1920, and the election to choose his successor was scheduled to take place the preceding July. From the very beginning there were only two noteworthy candidacies, those of Pablo Gonzales and Alvaro Obregon, the two generals of divisions who shared between them the command of the Carranza armies when they marched victoriously south in 1914. Gonzales is reputed to have spent five years as a youth in California, where he married his American wife. Later, he became a commander of *Rurales* (rural police) in Nuevo Leon, but was unknown to fame till he joined Carranza's forlorn hope to fight Huerta, in 1913. As a field-officer he showed some talent for organization but none for strategy, so that he doubtless owed his high command to the personal favoritism of the First Chief. Like most of the Carranza generals, he found revolution a profitable occupation and cleaned up perhaps the biggest fortune of the gang. In 1918 he possessed the huge sum required for planting and harvesting nearly the whole State of Morelos, then just won from the Zapatistas, and his total reward from his patriotic labors is estimated to exceed 5,000,000 pesos.

Younger by several years than his middle-aged rival, Alvaro Obregon hails from a small town in Sonora where he owned a farm and was mayor at the beginning of the revolution in 1910. He then raised a company of volunteers and did some fighting for Madero, but did not attain distinction until Sonora rebelled against Huerta in 1913. It was the Sonoran army that first successfully defied Huerta and saved Carranza when he fled west from his early defeats. Exhibiting marked military talent, Obregon soon rose to the command of the Sonoran army, and in 1914 he marched south along the west coast and captured Guadalajara, while the ever-victorious army of Generals Angeles and Villa was breaking Huerta's power on the central plateau.

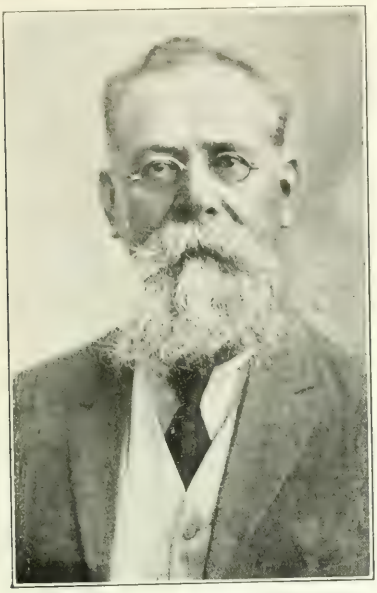
When Carranza was cast off as First Chief by the military convention at Aguascalientes, in October 1914, and had to flee for refuge to Vera Cruz, it was Obregon who led his Sonorans to the rescue and reorganized the army during the following winter. In his spring campaign against the Convention army led by Villa, Obregon re-captured Puebla in January, and by May had annihilated his opponents as a result of his victories between Celaya and Leon, where he lost his right army by a shell. Shortly after the transfer of the Carranza government to Mexico City, in September 1915, Obregon became Secretary of the Army and Navy, and held this post till his retirement from politics a year later, after his marriage to a Sonoran lady of large estate.

Until this spring, the presidential campaign proceeded along peaceful lines. Obregon toured the country to greet his partizans, and both he and Gonzales subsidized newspapers in the State capitals as well as in the metropolis. In the latter place, Obregon's friends started last summer 'El Heraldo' and this year 'El Monitor' as dailies, while Gonzales launched 'El Liberal'; all this in opposition to the old established dailies 'El Universal', 'Excelsior', and 'El Demócrata'. New posters announcing a candidate's merits were struck off every little while and pasted on the billboards of every post-office town in the country.

Carranza meanwhile remained, in his public utterance, quite neutral as between the rivals, and frequently announced his intention to abide by the letter of the law, both by holding the July election and by retirement in December in favor of the successful candidate; but suddenly he changed his attitude and Mexico awoke one morning in March to see blazoned on every billboard the posters announcing the launching of the presidential candidacy of Ygnacio Bonillas, then living at Washington as Mexican ambassador. Bonillas was born nearly 60 years ago in northern Mexico and completed his education for a civil engineer at the Massachusetts Institute of Technology, at Boston. Practising his profession for awhile in our South-West, he removed later to the northwest of Mexico, where he made a good income as an engineer. He joined Carranza's army in 1913 and so far gained the First Chief's favor that on the establishment of the Government at the capital in 1915, he was appointed a cabinet minister in charge of the Department of Communications. Well educated and of fair administrative ability, Bonillas, unlike the majority of his confreres, had kept himself clear of graft. He was as ideal a candidate, from every personal standpoint, as could be found among the Carranzista leaders, and had his backing been of a less sinister character, he might have caught the popular fancy. As it was, everyone began to ponder as to Carranza's motives in proposing Bonillas, and advertising him, regardless of expense, from Guatemala to the Rio Grande. Some said that he was booked for the rôle of the earlier Gonzales, the henchman of Porfirio Diaz, who held the presidential office after Diaz's first term, from 1880 to 1884, and amended the Constitution so that his master could legally get himself re-elected in 1884 and continue as president indefinitely. Others believed him to be a mere stalking-horse for Luis Cabrera, the Secretary of the Treasury and one of the most cunning hypocritical rogues of the Carranza gang; they anticipated that the presidency, once gained by Bonillas' popularity, would shortly be resigned in favor of Don Luis, the most cordially hated man in Mexico but nevertheless the right bower of the Carranza regime.

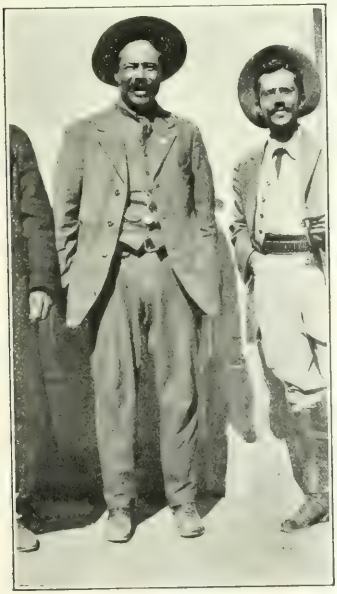
At the beginning of April, the Bonillas backers became bolder and summoned Obregon from his political campaign in Nuevo Leon to Mexico City, where he was accused of conspiracy in connection with the trial of Cejudo. The latter—a famous Zapatista general for many years in Vera Cruz—was accused of fraud, in that his recent acceptance of amnesty from Carranza had been merely the favorite Zapatista trick for re-stocking the surrendered troops with money and munitions as a preliminary to again becoming rebels. Although the letter incriminating Obregon with the Zapatistas was declared by Cejudo to be a forgery, the former was detained in the capital under surveillance "pending further investi-

gation". Soon eluding his captors, Obregon skipped to Michoacan, and his escape was the signal for the revolt



VENUSTIANO CARRANZA

ALVARO OBREGON



PANCHO VILLA

of Sonora, whose governor, Adolfo De la Huerta, proclaimed the Plan of Agua Prieta as the charter of a new revolution.

For several weeks the revolt progressed slowly. Carranza prepared to invade Sonora from Chihuahua and De la Huerta to capture Sinaloa. The legal governors of Michoacan, Zacatecas, and Guerrero declared for Sonora, as did also a number of rebel leaders; including the Zapatista, General Genevo de la O. of Morelos, the Villista, General Pelaez of Vera Cruz, and the Oaxaqueño, General Mexequiera. In later April, it looked as if the new war might continue indefinitely with Obregon

THE RURALES

holding the whole Pacific Coast region and Carranza the remainder of the country.

In the first week of May luck deserted its erstwhile favorite, Carranza, for General Pablo Gonzales joined the rebels, with most of the army of the East, captured Puebla, and threatened Mexico City. After sending

General Murguia south with 5000 men to hold Gonzales at bay. Carranza loaded 15 trains with his chief officials and valuables and prepared to repeat his manœvre of 1914 by retiring his government to Vera Cruz. Yet history refuses to repeat itself on demand, so Carranza never reached Vera Cruz, but was overwhelmed by the enemy near the eastern edge of the central plateau and obliged to flee on horseback into the mountains of Puebla with a few followers. Here the end came suddenly on the night of May 22, when Carranza was shot by an attack on his tent by a body of supposedly friendly troops. Amnesty to leave the country was even then on its way from General Obregon, but it arrived too late to save the fallen dictator.

Meanwhile the triumphant revolutionists had entered Mexico City with the semi-savage horde of Genevo de la O. and had domiciled Obregon in the Hotel St. Francis and Pablo Gonzales in the National Palace. Following the Plan of Agua Prieta, the Congress was called in session to elect a provisional president, and on May 24 chose Adolfo De la Huerta to fill out Carranza's unexpired term of seven months. The election for the new President and Congress was also postponed from July till the first Sunday in September. Soon thereafter, all Carranza's governors and generals, who had not already turned over or been captured, tendered their submission, so that the Obregon revolution was finally achieved by June first with a minimum of bloodshed and destruction and with scarcely any damage to civilians.

Although nominally a Federal republic, under the Constitution of 1857 and even more that of 1917, the national President has found it easy to centralize the powers of the States in the Federation and to control the latter as he wished. In fact the recent imposition by Federal fiat of governors on the States of Queretaro, Guanajuato, Tamaulipas, and San Luis Potosi was one of the chief accusations brought against Carranza in the Plan of Agua Prieta. However much the President's arbitrary power may be criticized by his opponents, such power—equivalent to that of a military dictatorship—seems to be necessary if the barbarous masses of Mexico are to be kept within the bounds of a civilized order. The all-important public question then is the personality of the dictator, for upon his nod hangs the woe or weal of millions. As Pablo Gonzales has just withdrawn his candidacy, the election of Obregon is practically assured and his character thus becomes of supreme importance to everyone interested in Mexico. Will Obregon, like Carranza, continue to humor the brigand generals of the army and the grafting chiefs of the civil service; and will he likewise be helpless to restrain the bands of rebels who have infested every fertile rural district? Will Obregon also flout foreigners, especially Americans, and deride their pleas for damages by a Claims Commission that carefully files every brief but never pays a cent? Upon the answer to these questions depends the fate of Mexico as soon as the chief foreign sponsor for the Carranza government retires from office next March.

As Obregon's public career to date has been purely military data are lacking for any exact prediction as to his reaction when invested with the civilian power. Although his troops were probably no more respectful of private property when on campaign than those of other leaders, I have no evidence that he ever used them as looters for his personal enrichment as was the practice of many of his confreres. His retirement from his high office in 1916, just when the national harvest of graft was most bountiful, indicates anyhow that avarice is not his ruling passion. Of only a mediocre education like Carranza, Obregon is free from the petty jealousy that rendered the former so incompetent as an administrator. Carranza would have no one near him whose intellect surpassed his own, and was once heard to remark: "I don't want ministers in my cabinet, but just clerks who will do my will". On the contrary, Obregon realizes his own limitations and has made his success by his wise selection of the best talent available for aids. An amateur strategist, he was yet able to beat the semi-professional army of Villa in the Celaya campaign by his practice of never making an important move without a council of war. Of proved bravery as a soldier, Obregon should carry into the presidency the courage required to suppress any malefactor however powerful—a courage that Carranza never had.

Since his recent triumph, Obregon's public statements of policy have been reassuring. He not only sustains the Plan of Agua Prieta in guaranteeing the inviolability of private life and property, but has promised to forgive all his political and military opponents except those guilty of vulgar crimes. He tells foreign investors that they will be again welcome in Mexico and assures them that those paragraphs of the new Constitution which infringe their just rights will be eliminated by legal amendment. Toward the perennial rebel political movements he has adopted a conciliating policy and has thereby done more for pacification in a few weeks than Carranza was able to do in five years with a huge army. The rebel generals, Pelaez of Vera Cruz, Mexequiera of Oaxaca, Genevo de la O. of Morelos, and Felix Diaz of the south-east coast have already laid down their arms, along with many lesser lights, and Villa seems to be the only important rebel who is still recalcitrant.

Free from avarice, competent as an administrator, courageous as a lion, friendly to foreigners, and conciliatory toward his opponents, Obregon offers every hope of being able to restore Mexico to the honored place among nations she held under Porfirio Diaz.

NICKEL-COPPER ORE to the amount of 301,133 tons was mined and 238,700 tons was smelted in Ontario during the first quarter of 1920. Shipments of matte totalling 10,168 tons were made to the refineries in Canada, United States, and Great Britain. The British America Nickel Corporation is producing matte at Nickelton and shipping to the refinery at Deschenes, Quebec. The latter is now in operation, although there was no output for the first quarter. A considerable part of the nickel oxide produced at the Port Colborne refinery of the International Nickel Co. of Canada is marketed in that form in England.

The Testing and Application of Ventilating-Fans

By WALTER S. WEEKS

DEFINITIONS. The efficiency of a machine is the percentage of the power input that is recovered in useful work; it is the useful work that it does in a given time divided by the power input.

A ventilating-fan is given credit for the static head that it produces and for the velocity-head that it produces. The pressure that a pressure-fan maintains to overcome the mine resistance is called the static pressure, and the pressure corresponding to the velocity-head which the air possesses when it leaves the fan is called the velocity-pressure. The sum of the two pressures is known as the total or dynamic pressure. The total pressure multiplied by the quantity per minute in circulation gives the useful work; this divided by 33,000 is the horse-power that 'shows up' in useful work in the air.

FAN-TESTING. In order that a fan may be tested, it must be operated at constant speed under varying conditions of resistance. Tests may be run at any speed. The resistance is obtained by interposing orifices of various sizes in the duct leading from the discharge in the case of a pressure-fan; and in the duct leading to the intake, in the case of an exhaust-fan. The orifice is placed at the end of the duct. With small fans a pipe serves as the duct, and with large fans an artificial drift must be constructed. A frame in which are placed any desired number of slats is a convenient type of variable orifice. Fig. 1 shows a model of such a frame. The duct should be long enough to smooth out the eddies and establish a steady flow. The length of a circular duct is usually made 50 times the diameter.

In mining work the over-all efficiency of the fan and motor, or fan and engine, is obtained. To determine the efficiency of the fan itself a transmission dynanometer is necessary, or else the efficiency of the motor and transmission must be separately ascertained. In the following discussion I shall use the manometer readings in inches of water as a measure of head or of pressure.

A fan may be operated as a pressure-fan, as an exhaust-fan, or as a combination pressure-and-exhaust fan, so we must understand the methods of determining the total pressure under these conditions. Let us first consider the pressure-fan.

The arrangement for the test is shown in Fig. 2. The adjustable orifice is at *a*. At *b* a tube is inserted with a pin-hole opening facing the side of the pipe. This tube is connected with a vertical manometer like the one in Fig. 3. The scale on the manometer is a flat 'engineer's scale' reading to decimals of an inch and arranged so that the bottom edge, which is the zero of the scale, may be set opposite the water-level in one leg of the manometer. The method of mounting the scale is shown in Fig. 4.

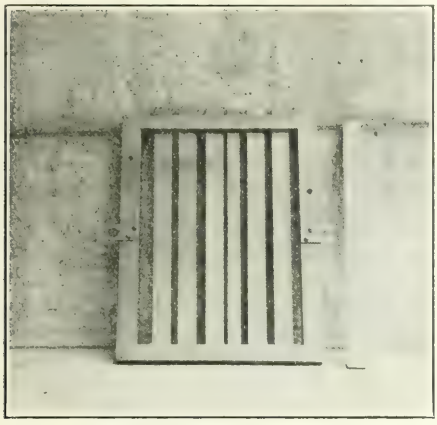


FIG. 1. ADJUSTABLE ORIFICE

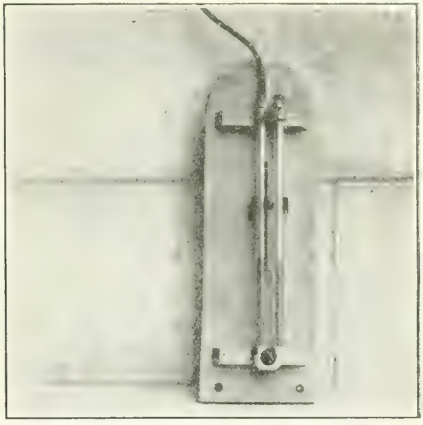


FIG. 3. VERTICAL MANOMETER

The Pitot-tube readings for velocity should always be taken in the duct midway between the fan and the orifice. The manometer, under the conditions shown in Fig. 2, records the friction and shock losses that the air undergoes after passing the point *b*. We credit the fan with this static pressure. In addition we must credit the fan with the velocity-head in the air at the point *b*. For example, let us suppose that the area of the pipe is one square foot and 3000 cubic feet per minute is flowing. The manometer reads 4 in. The weight of one cubic foot of air is 0.08 lb. Let us determine the

total pressure and the horse-power in the air.

The velocity is 50 ft. per second.

$$\text{Velocity-pressure} = \frac{v^2}{2g} = \frac{0.08 \times 2500}{64} = 3.12.$$

Velocity-pressure = 3.12 lb. per square foot.

$$\text{Velocity-pressure in inches of water} = \frac{3.12}{5.2} = 0.6$$

Total pressure in inches of water = 4.0 + 0.6 = 4.6.

Total pressure in pounds per square foot = 4.6 × 5.2 = 23.9.

$$\text{Horse-power} = \frac{23.9 \times 3000}{33{,}000} = 2.2.$$

Let us consider next the exhaust-fan arranged as in Fig. 5. The manometer is connected at *a*. The pressure at *a* will be below that of the atmosphere. Conditions are quite different from the case we have just discussed. In the case of the pressure-fan, the pressure recorded by the manometer did not cause the air to flow; it did not impart the velocity-head to the air; the air received its velocity in the fan before it reached the manometer, so the reading did not include the velocity-head.

In the case of the suction-fan, the atmospheric air is still. The fan produces a depression, and this depression, or difference in pressure between the outside air and the fan-inlet, must not only overcome friction but it must supply the velocity-head to the still air when it enters the pipe. A manometer arranged on an exhaust-fan as in Fig. 5 records the total pressure produced by the fan.

The fact to fix in the mind is this: if the pressure measured causes the flow, the velocity-pressure is included in the manometer reading. If we had a pressure-fan arranged as in Fig. 6, where the air is brought to a negligible velocity before entering the pipe, the manometer would record the total pressure, because the only source of velocity would be the pressure in the chamber. The usual arrangement of a pressure-fan is that of Fig. 2, where the manometer does not measure the velocity-head. Now let us attack the problem of a combination pressure-and-exhaust fan.

There are three subdivisions under this head that demand attention. The discharge-pipe is (*a*) the same size as the suction-pipe, (*b*) smaller than the suction-pipe, or (*c*) larger than the suction-pipe. Two manometers are necessary, one at the inlet and one at the discharge. We must be careful that we do not credit the fan more than once with the velocity-head. Let us consider the condition where both pipes are of the same size. The velocity-head in the discharge-pipe is the same as that in the suction. The manometer on the suction gives friction and shock losses in the suction-pipe, and velocity-head in the suction-pipe. The manometer on the discharge-pipe gives friction and shock losses in the discharge-pipe, so the sum of the two manometer readings is the total pressure produced by the fan.

If the discharge pipe is smaller than the suction-pipe, there has been a gain of velocity-head. The fan must be credited with this gain. An example will illustrate: The suction manometer reads 3 in. and the discharge manometer 4 in. The size of the suction is one square foot, and that of the discharge is half that; 3000 cu. ft. per minute is circulating. Weight of air is 0.08 lb. per cu. ft. Determine the total pressure.

The sum of the water-gauges is 7 in. This includes friction in both pipes and velocity-head in the suction. The velocity-head in the suction is 0.6 in. The velocity in the discharge is twice that in the suction, so the velocity-head in the discharge is four times that in the suction, or 2.4 inches.

The gain in velocity-head is 2.4 − 0.6 = 1.8.

So the total head is 7 + 1.8 = 8.8 inches.

If the discharge-pipe is larger than the suction-pipe, it is assumed that the fan has recovered some of the velocity-head of the suction-pipe, therefore the decrease in velocity-head is deducted from the sum of the two manometer readings.

In all cases the horse-power in the air is computed by the formula:

$$\text{Hp.} = \frac{P\,Q}{33{,}000}$$

P = Total pressure in pounds per square foot.

Q = Quantity in cubic feet per minute.

In running a complete fan-test, the orifice is first entirely closed, and the pressure readings taken. Air is then admitted in stages, and at each stage the quantity is determined with the Pitot tube, and the pressure readings and power measurements are taken. With these data the working characteristics of the fan may be plotted.

With cubic feet of air per minute as abscissae, we may plot curves of static pressure, total pressure, velocity-pressure, and efficiency.

The Equivalent Orifice of a Mine. In the fan-test the resistances interposed are orifices of various sizes. If we know the pressure necessary to overcome friction in a mine when a given quantity of air is flowing, we can calculate the size of the orifice that will offer the same resistance. Such an orifice is called the 'equivalent' orifice of the mine. The conditions that exist when a fan is connected with an equivalent orifice may be represented by Fig. 2. The fan will maintain some pressure in the pipe. Air will flow out through the orifice according to the law $v = \sqrt{2gh}$. The static pressure-head in front of the orifice is first converted into velocity-head and the air flows through the orifice. When it meets the still air outside, the velocity-head is destroyed by shock. The actual pressure that causes the flow through the orifice is the static pressure plus the velocity-pressure in the air as it approaches the orifice. This velocity of approach is ordinarily so small that it may be neglected, and the flow calculated as if it were due to the static pressure alone.

Let A be the area of the orifice to be determined.

v = Velocity in feet per second.

q = Quantity in cubic feet per second.

$v = \sqrt{2gh}$.

$A\,v = q$.

When air flows through an orifice under a constant head, the area of the stream contracts so that the actual

amount flowing is only 64% of the theoretical amount.

$$q = 0.64\, A \sqrt{2\,g\,h}.$$

$$A = \frac{q}{0.64 \sqrt{2\,g\,h}}$$

Let Q = quantity in cubic feet per minute.
i = pressure in inches of water.
0.075 lb. = weight of one cubic foot of air.

Then $$A = \frac{0.0004\,Q}{\sqrt{i}}$$

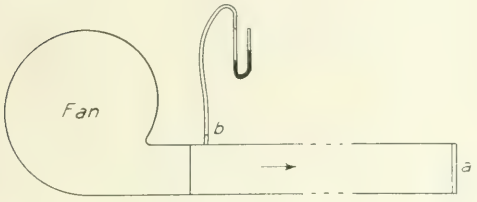


Fig. 2

Example: It requires a water-gauge of 4 in. to force 100,000 cu. ft. of air through a given mine. What is the equivalent orifice?

$$A = \frac{0.0004\,Q}{\sqrt{i}}$$

$$A = \frac{40}{2} = 20 \text{ sq. ft.}$$

The principle of the equivalent orifice may be used to determine whether a fan will accomplish a given result. For example, suppose that you wish to force 3000 cu. ft. per minute into a pipe in a drift and it requires 12 in. of water to do it. You have on hand a fan that you would like to use. Connect a pipe and orifice to the fan.

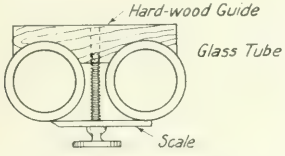


Fig. 4

Close the orifice until the pressure rises to 12 in. (if it ever does) and measure the air. If 3000 cu. ft. or more is passing, the fan will do the work. If the fan when running at the maximum speed never gives a water-gauge of 12 in., or if when the water-gauge is 12 in. less than 3000 cu. ft. is passing, the fan will not do. Such a short-cut method would not be used in selecting a big fan because the efficiency of the operation must be considered carefully.

The Door-Regulator. The approximate opening of a regulator in a mine-door is figured in the same manner as the equivalent orifice. It will be recalled that the resistance of a split must often be increased to prevent too much air from passing through the split. Let us see how the regulator destroys pressure. Referring to Fig. 7, a given quantity of air is circulating in the drift with a velocity of V feet per minute. In a door a is an orifice the size of which is controlled by a sliding gate. The velocity increases when the air passes through the orifice. This increase in velocity-head is accompanied by a decrease in pressure-head. If this increase in velocity-head is then destroyed, we have thus destroyed a certain amount of static pressure. The velocity-head in the drift itself is usually so small that it may be neglected. That being the case, the size of the opening of a regulator necessary to destroy a given amount of static pressure may be computed with the equivalent orifice formula.

$$A = \frac{0.0004\,Q}{\sqrt{i}}$$

In this case i is the number of inches of pressure that we wish to destroy. After the air passes through the regulator at high speed it strikes the slow-moving air in the drift, and swirls and eddies until it finally slows

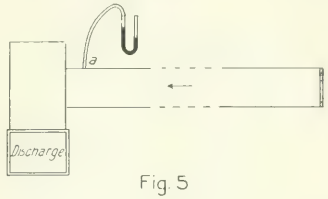


Fig. 5

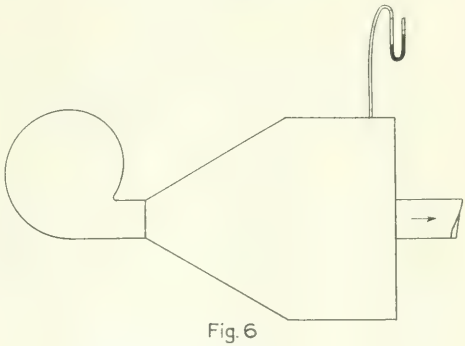


Fig. 6

down to the normal speed of the drift. This formula is used to determine the approximate size of the regulator, and then it is adjusted until the correct amount of air is shown by the anemometer. Example: the resistance of a drift when 15,000 cu. ft. per minute is flowing is two inches. The resistance must be increased to 4.25 in. with the same amount of air. Determine the regulator opening.

The regulator must destroy 2.25 inches.

$$A = \frac{0.0004 \times 15{,}000}{\sqrt{2.25}}$$

$$A = 4 \text{ sq. ft.}$$

Changes of Velocity. In the first article of the series* we studied the friction of the ventilating air and we saw that we must apply enough static pressure to overcome the friction of the circulating air. We must do more than this; we must supply enough additional pressure to account for such increases in velocity as may take place.

*'M. & S. P.', April 24, 1920.

Consider Fig. 8. Suppose air is moving 500 ft. per minute in the drift *A B*. The area of *B C* is half the area of *A B*, so the velocity in *B C* is 1000 ft. per minute. This increase in velocity-head must come from the static pressure at *a*, so the static pressure at *b* will be less than the static pressure at *a* by an amount equal to the gain in velocity-head. Now, when the stream of air enters *B C* it contracts, so the speed at entrance must be greater than the speed after the air fills the whole drift. When an orifice such as the opening of a drift or shaft is followed by a duct of the same size, the coefficient of contraction is about 0.82, so the velocity-head at the entrance will be 1.5 times the velocity-head in the drift after the air fills the drift. So half the normal velocity-head in the drift *B C* is lost in shock at the entrance. If the

Fig 7

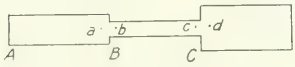


Fig 8

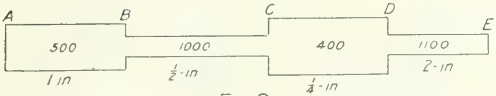


Fig 9

change in size were made gradually, this shock loss would not occur.

If the drift *B C* opens into a larger drift, the fast-moving air in *B C* strikes the slow-moving air in *C D* and the difference in these two velocity-heads is lost in shock. If the change were made by a gradually expanding cone, part of the velocity-head would be recovered and the static pressure at *d* would be greater than the static pressure at *c*. In practice, however, no velocity-head would be recovered because no attempt is made to save it. So if the velocity increases we must add the increase in velocity-head to the mine resistance; if velocity decreases we neglect it. Let us now take a short example of selecting a pressure-fan for a small mine considering the changes of velocity. See Fig. 9.

The fan situated at *A* is to force 50,000 cu. ft. of air through the openings as shown. The friction is first calculated, and this is given in inches of water below the drifts. The figures in the drifts indicate the velocity of the air in feet per minute. The problem is to determine the water-gauge at which the fan must operate.

Assuming that an air current with a velocity of 4000 ft. per-minute has a velocity-head equivalent to one inch of water:

Increase in velocity-head at *B* . . $1.5 \times 0.063 - 0.016$	$= 0.078$
Decrease in velocity-head at *C*	(neglect)
Increase in velocity-head at *D* . . $1.5 \times 0.076 - 0.01$	$= 0.104$
Total increase in velocity-head	0.182
Friction	3.75

The fan for this mine must be able to supply 50,000 cu. ft. of air per minute at a static pressure of 3.93 in. of water.

If there are but few velocity changes, they may be neglected, but if there are many in series, their sum may be appreciable.

Now let the fan be an exhaust-fan situated at *E*, with the air circulating as before. We must now maintain a slightly greater difference in pressure between the two ends, because it is now necessary to give velocity to the still air outside in order to make it enter the mine. The velocity in the first drift is 500 ft. per minute. This is equivalent to 0.016 in. of water. The velocity-head at entrance is

$$1.5 \times 0.016 = 0.024$$

Since the velocity-head outside is zero, this is the gain in velocity-head.

The suction-fan must maintain at the fan-inlet a static vacuum, as it is called, of

$$3.93 + 0.024 = 3.95 \text{ in. of water.}$$

A manometer at the fan-inlet of an exhaust-fan measures friction and all the velocity changes that take place from the still air outside. A manometer at the discharge of a pressure-fan measures friction and all the velocity changes that take place after the air has passed the manometer. It does not measure the velocity-head in the air in the first drift. The air possessed this velocity before it reached the manometer.

High-Pressure Fans. Up to the present we have been dealing with fans that supply a large amount of air at low water-gauge. This sort of fan is adapted to mine ventilation when the ducts are the ordinary mine openings. There is another type of ventilation no less essential, namely, the ventilation of drifts and tunnels while they are being driven. For such work, a pipe-line is run from the entrance to the breast and the air is either forced in through the pipe or sucked out through the pipe. Such a ventilating system demands a much higher pressure; for instance, to force 2000 cu. ft. of air per minute through a 12-in. pipe 4000 ft. long requires a pressure of about 40 in. of water.

Ordinary centrifugal blowers can be obtained that will deliver at pressures up to 1.5 lb. per square inch. To obtain pressures above this we must use a centrifugal compressor or a positive-pressure blower. A centrifugal compressor is built much like a high-grade turbine-pump with diffuser-vanes. A single-stage centrifugal compressor may be obtained to give pressures up to 4 lb. per square inch.

In tunnel work it is often desirable to reverse the air current. By means of a 'four-gate system' either the discharge or the inlet can be connected to the pipe. With high-pressure fans or centrifugal compressors, a smaller water-gauge will be produced when the fan is exhausting than when it is blowing, provided the speed and quantity be the same. This is because the density of the air handled is less when the fan is exhausting.

If the pressure that a fan or centrifugal compressor will produce when blowing is known, the suction-pressure

that the machine will produce may be computed by utilizing the simple rule, that with a given speed and quantity the ratio of the absolute discharge-pressure to the absolute inlet-pressure is a constant.

Let P be the absolute discharge-pressure.

Let P_1 be the absolute inlet-pressure.

Then $\frac{P}{P_1} = C$

Example:

A fan blowing gives a pressure of 40 in. of water. What suction-pressure will it create when exhausting?

Let the atmospheric pressure be equivalent to

407.2 in. of water.

Conditions when blowing.

$$P = 40 + 407.2 = 447.2$$
$$P_1 = 407.2$$

When exhausting, P will be at atmospheric pressure, and P_1 will be determined.

$$\frac{447.2}{407.2} = \frac{407.2}{X}$$
$$X = 370$$
$$407.2 - 370 = 37.2$$

So the suction-pressure is 37.2 in. below the atmosphere.

A centrifugal compressor gives 4 lb. per square inch in blowing. What negative pressure will it create?

Assuming that atmospheric pressure is 15 lb. per square inch,

$$\frac{19}{15} = \frac{15}{X}$$
$$X = 11.8$$
$$15 - 11.8 = 3.2$$

The negative pressure produced when exhausting will be 3.2 lb. per square inch.

[This is the fourth of a series of articles by Professor Weeks on the ventilation of mines. The first article appeared in the issue of April 24, the second in that of June 12, and the third was in the issue of June 19.—EDITOR.]

Manufacture of Aluminum

The possibilities of manufacturing aluminum by hydro-electric means at The Dalles, Washington, is discussed in Bulletin No. 5 of the Engineering Experiment Station at the University of Washington by Charles D. Grier. The manufacture of aluminum requires two steps: the preparation of pure alumina, the oxide of aluminum, from the ore, bauxite, and the solution and electrolysis of this alumina in a bath of molten cryolite, resulting in the deposition of molten aluminum at the bottom of the bath. Bauxite, which is the natural hydrated oxide of aluminum, is never pure enough as mined to be used without purification. This is accomplished by calcining the ore, dissolving in caustic soda, precipitating alumina from this solution, and calcining the resulting precipitate. This purified alumina is then fed at intervals into a bath of used cryolite which is contained in a box-like furnace or pot, the bottom of which acts as a cathode. The anodes are specially prepared amorphous carbon blocks suspended in the bath, and are gradually consumed by the oxygen liberated. The bath is kept molten by the heat generated by the passage of the current. The raw materials required for the manufacture of aluminum are bauxite, coal, and caustic soda for purifying it, cryolite, and carbon in some form (usually as petroleum-coke) for making electrodes. There are no bauxite deposits of large size known in Western States. If domestic ore were to be used in a plant in Washington, it would be necessary to procure the ore from the Eastern deposits, those in Arkansas being the nearest and also of the highest grade. Large deposits of high-grade bauxite were being opened up in British Guiana before the War, and a considerable amount of this material has been used at the Soller's Point plant of the Aluminum Company of America, in Maryland. Permits for developments beyond those then licensed were not granted by the British government during the War, and it is said that operations in the future are to be governed by the policy of conserving the mineral wealth of the British Empire for itself. If these deposits become available they might be a very attractive source of raw material for an aluminum plant on the Pacific Coast. Deposits of bauxite are also found in Dutch Guiana. India produces bauxite of high grade, and ore from that source might also be available. These latter sources involve ocean transportation, however, and although this may be an advantage when the shipping industry becomes more nearly normal, it is thought best not to consider the use of these ores in this discussion. Cryolite is mined in Greenland, which furnishes the world's supply. It is possible to substitute an artificially made fluoride of aluminum and sodium; this is done to some extent by the European manufacturers. Coal and caustic soda for bauxite purification are readily available both in Arkansas and in Washington; purification of the bauxite at the mine would, however, save freight. Petroleum-coke is readily available from the oil-refineries; charcoal could also be readily obtained if a steady and reliable demand for it were assured.

The production of aluminum in the United States in 1917 was estimated to be 200,000,000 lb., which is nearly triple the production in 1913. The average yearly increase since 1913 in the annual production was about 34,000,000 lb. The 1917 production may be taken as a measure of the capacity, for all plants were working at full capacity. It is stated that this capacity will be doubled by the completion of the plants of the Cheoah Aluminum Co., a subsidiary of the Aluminum Company of America, thus making the producing capacity roughly four million pounds per year. It is difficult to forecast future consumption, but it is evident that the present American producer is providing ample capacity to take care of a great expansion of demand, and that any new company entering the American market would have strong competition. The conclusion is that the erection of a plant on the Pacific Coast at the present time is not justified.

The Ore Deposits of Mexico—IV

Ore Deposits in Limestone and Not of Direct Igneous Origin

By S. J. LEWIS

Introduction. In the foregoing articles I have discussed Mexican ore deposits in sedimentary rocks in which a close association can be established with igneous intrusives. There is a large number of mines in Northern Mexico where such an association cannot be proved. In this class of deposits, confined exclusively to the base metals, nearly every condition is similar to those found in the other classes of orebodies, except for the lack of an igneous rock in contact with the mineralization or close to it. In this class the sediments are disturbed, broken, and highly altered in the immediate neighborhood of the orebodies as by hot solutions and vapors. The ores themselves, with their gangue, are in all important respects similar to the products of mineralization in the cases of admitted igneous influence. Hot or tepid mineral springs in the neighborhood of some of these deposits give evidence of expiring vulcanism, establishing the existence in the locality of a deep-seated source of magmatic emanations. While exploration in most of these will probably never go deep enough to prove such igneous connection, the inference is warranted that igneous intrusives, buried under the sediments, are the ultimate source of the hot solutions that mineralized these deposits, at least as regards the primary ores. In most of these cases, pay-ore has been made largely by oxidation due to secondary agencies.

The Cabrillas Group. This group of lead-zinc-iron mines, comprising the Cabrillas, Palomas, and Higueras properties, besides adjoining prospects, are in the State of Coahuila, mid-way between Monterrey and Saltillo. They are of comparatively recent discovery, having risen to importance owing to the requirements of local smelters for fluxing ores. The ores are oxides of lead, iron, and zinc, the last occurring in large and profitable bodies in the Palomas. Unoxidized cores of galena are common in specimens of the better ore.

"The limestone ridge in which these orebodies occur has a general east and west axis, with spurs radiating northward into the valley. The mineralization is in a belt of black, shaly, badly-crushed limestone."[17] The ores were deposited in pipes or chimneys, in open or in partly open caves, and as replacements of strata connected with the chimneys, all along the great fracture that goes through the mountain from the Cabrillas to the Palomas side and through to the Higueras mine across the next arroyo. This great fracture is the arresting feature of the deposits. From the Palomas side it shows up well, with the heavily folded strata changing rapidly from the nearly horizontal position where undisturbed to the steep inclination into which the movement pushed them. It is a typical break like that with which similar deposits are so often associated in Northern Mexico, its special feature being great size. No intrusive igneous rock is known in the immediate neighborhood. The adjacent hills, which show no signs of fracturing, do not contain ore deposits, so far as known. The known ore is bottomed by a thick sheet of highly altered rock made up principally of gypsum, the full thickness of which has never been determined. When the deposits are followed down to this gypsum formation their richness diminishes, finally to extinction, the fracture meanwhile pinching to a small crack that cannot be followed.

In every essential feature, except the visible presence of an eruptive or intrusive rock, the deposits are similar to typical contact orebodies in limestone such as those we have been discussing. We have a huge channel through the limestones, at high angles to the bedding-planes, with the sediments sloping away from the fractures on both sides. We have the oxidized ore deposited along this channel, replacing the lime strata in some places and filling open spaces in others. We have the highly-altered "black shaly" limestone in the immediate vicinity of the orebodies, although the country-rock is the ordinary blue limestone of the Cretaceous. Such alteration is very suggestive, like the other conditions, of a deep-seated source, from which mineralizing solutions worked their way up and caused deposition in the fracture. As has been said in a somewhat different connection, "the cause is found at some point below the effect, pointing to a reaction between an ascending mineralizer and the limestone".[18] The only cause that could satisfy the conditions of the problem would seem to be a deeply-buried intrusive mass, whose forced entrance into the ground would be amply sufficient to cause the fracturing, and from which the mineralizers have since made their devious way upward. In no other way can this local break be explained: regional folding in the general course of mountain-making could hardly have made such a fracture system and left everything in the immediate neighborhood practically undisturbed. In shape, size, orebodies, and general features, the deposits belong to the contact group, except for the unknown intrusive.

Mitra Mountain. Similar low-grade lead-iron ores were found in considerable tonnage in Mitra mountain near Monterrey, some twenty-odd years ago and a good

[17] Lewis, S. J., 'Cabrillas Lead Mines', 'E. & M. J.', Vol. 89, p. 1071.

[18] Prescott, Basil, 'Economic Geology', Vol. X, p. 61.

deal of it has been used by local smelters. The mountain gets its name from the striking resemblance its three-pointed crest bears to a bishop's mitre, when seen from the city. Monterrey stands on a little plain, hemmed in by high mountains carved out of the limestone strata. Like them, the Mitra rises almost sheer from the flat; on closer acquaintance, it turns out to be much longer than one would suppose in viewing it from the city, and to be approachable on the west side by small foothills that break the ascent. On the east it is all but insurmountable for the average climber. As in all this region, the folding has been severe, and erosion has usually cut through the upper parts or anticlines. The mitre-shaped crest is formed by blocks of the anticlines left as small spires; in most of the surrounding mountains, such spires have been removed, leaving only the sharply-tilted strata of the hillsides, with the domes cut off, so that the ends of the beds go down on the opposite sides like huge irregular steps. The Mitra is a conspicuous exception; it shows a gently-sloping dome on its longer axis, broken here and there by transverse fractures, and capped by the spires remaining from the uppermost strata. Its summit is over 5000 ft. above sea-level.

The ore deposits are of the reddish-brown earthy oxide type, with a little lead, a few hundred grammes of silver, considerable iron, and a low percentage of insoluble: hence 'neutral' or better, and desired by the smelter. The ore occurs in irregular bodies, filling caves in the limestone along a line of fracturing, or replacing certain strata. In the former case, the trail of mineralization can generally be followed, with patience and skill, from one cave orebody to the next; in the case of the blanket deposits, the mineralization generally can be traced from one of the dominant fractures, as in the true contact deposits. The most important feature of the Mitra deposits is the fact that all pay-ore to date has been found in strata of dolomitic limestone near the crest of the mountain, where the fractures go through them. Above this dolomite horizon, only low-grade iron ores have been found, exclusively in the anticline. There is considerable dissemination of galena crystals in the limestone above the ore-horizon. No heavy fracturing is visible at any point. Nevertheless, lines of weakness at the anticlinal folds have served as channels for mineralizers from below, where solutions could react with the wall-rock, widening the channels and depositing the mineral. See Fig. 15.

The accepted theory for the origin of these deposits, based on J. E. Spurr's work in 1906 in the Diente deposits on the other side of the city, shows that the metallic minerals were precipitated out of solution by the selective action of certain sediments in which fossils are especially abundant. A similar action will be shown to have influenced the deposition of antimony ores at Wadley, south of Catorce. The present paper is more especially concerned with the origin of the mineral-bearing solutions that found their way into the favorable horizon.

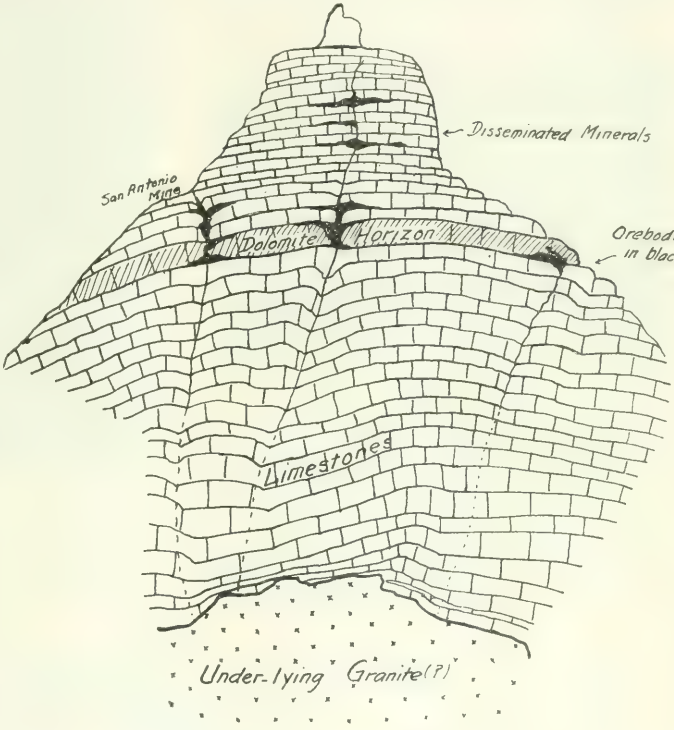


FIG. 15. LA MITRA

In accord with the views herein expressed, their origin must be sought in deep-seated igneous bodies lying below the limestone. There is no intrusive structure visible anywhere near the deposits, and the lines of circulation in the anticlinal domes may have originated in the crumpling and folding of the sediments. The origin of the mineral that in one form or another found its way into these channels is, however, a more difficult matter to determine.

The precipitation products of similar solutions will be similar; if the ores of various deposits are closely alike, it would certainly seem that the original solutions from which they came could not have differed markedly. All of these lead-zinc deposits in Northern Mexico have much the same features of occurrence and mineralization as are found in the numerous lead-zinc deposits in the same region where the intrusive is known to exist. For ex-

ample, the principal structural difference between these Mitra deposits and those of the Santa Rosa range near Muzquiz, State of Coahuila, is that, in the latter, evidences of vulcanism are abundant, instead of being deeply buried as in the Mitra. The Cedral mine, for instance, in the Santa Rosa area, is on a fracture showing a strik-

FIG. 16. WADLEY ANTIMONY MINES

ing resemblance to the Cabrillas fracture. At Topo Chico, a few kilometres from the Mitra, profitable deposits of lead and zinc have been found in ground entirely like the Mitra formation; with the difference that the mineral springs close-by suggest a connection with underground sources of mineralization. The fact is that in all these mines, the ore occurs either in fractures or close to them in the anticlines, not disseminated over

The one visible structure of igneous origin in the district is the vast field of granite, which outcrops about 30 km. north of Topo Chico and is such a prominent feature of the Bustamante and Villaldama topography. The in-

FIG. 17. COLA DE ZORRA MINES

fluence of this intrusive mass would be quite sufficient to account for the neighboring ore deposits; and it would seem entirely probable that similar occurrences of gran-

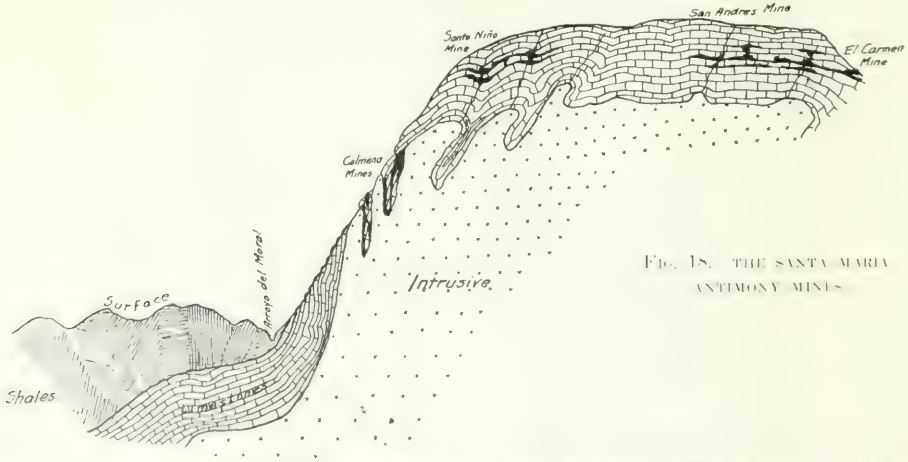


FIG. 18. THE SANTA MARIA ANTIMONY MINES

undisturbed areas. The most satisfactory hypothesis of origin would allow for the existence during some bygone period of deep-seated mineralizing influences that became effective through the dislocation of the strata

ite, related to the Bustamante rock, underlie the Monterrey lead-zinc district and are responsible for the mineralizing emanations that made their way up to the limestone and deposited the ore.

The antimony deposits near Wadley, in the State of San Luis Potosi, have been mentioned as showing the influence of the organic remains due to fossils on ore deposition in adjoining strata. They furnish an interesting example of mineralization in limestone clearly to be ascribed to mineralizers from deep-seated sources, yet which cannot be connected directly with any near-by volcanic mass. The district is 16 km. south of the Catorce Real, hence it is an outlier of the andesite-limestone contact district of Catorce. The only volcanic rock I have seen near the Wadley deposits is found in arroyos at the southern end of the district, where dikes of reddish-brown doleritic rock appear crossing the formation. The antimony mineralization is entirely in the blue limestone high on the mountain wall, and shows no admixture of any common metal or of gold or silver. A little cinnabar is frequently found coloring the antimony crystals, and in certain veins carrying no antimony a little lead has been observed. As a whole it is strictly an antimony deposit, the ore occurring chiefly as replacements in certain strata, but the mineralization nearly always proceeds outward into those strata from vertical fractures crossing the formation.

The principal mines are at Tierras Prietas, near San Jose village, 8 km. east of the railway station at Wadley. In these the ore occurs in each of three parallel and nearly vertical fissures, running nearly north and south for a distance of over a kilometre, and cross-faulted in two places, the displacement being but a few metres eastward. The strata are nearly horizontal at the top of the mesa, and at a short distance below the surface some of them have been extensively replaced by irregular bodies of antimony, usually in crystalline form, penetrating the limestone. The accompanying photograph (Fig. 16) shows the two principal blankets, crossed by the Treinta-y-Uno cross-vein, all heavily ore-bearing. The principal lode, already mentioned, makes another set of crossings with these, as it runs parallel to the edge of the mesa.

These deposits have been partly mined to a depth of 100 m. below the outcrop, there being as yet no change observable in the ore in that depth. The ore is antimony oxide, chiefly valentinite, usually in fine crystal aggregates. Individual crystals are sometimes ten to twelve inches long. Stibnite is occasionally found, also crystalline, and nearly all the oxide crystals have a core of sulphide. A good deal of the product is in the form of amorphous mineral taken out as an earth of rather lower grade than the coarse ore. Oxidation has certainly been very thorough in these deposits, yet the evidence of the original sulphide deposition is indisputable.

A striking and noteworthy feature of the deposits is the occurrence of especially good orebodies at the intersections of vertical fractures with certain strata having a favorable chemical reaction. The accompanying sketches (Fig 19) show the mode of occurrence of the ore under variants of these conditions. Several cases show fine bodies in the anticlinal folds where cut by a vertical fracture; others in the syncline where cut in the same way; and still others in practically level horizons. In every case, the richest ore is found in the vertical fissure, diminishing in quantity and grade as it goes outward from the fissure and penetrates the strata. It is evident that the ore deposition was principally from magmatic vapors under high temperature, which carried in the antimony in a state of volatilization, and which dropped their metallic burden under certain conditions of temperature and reaction with the strata. Whatever the cause of the fracturing, the mineral must have come from a source of great heat and pressure, corresponding to some deeply-buried volcanic mass, in which the antimony minerals

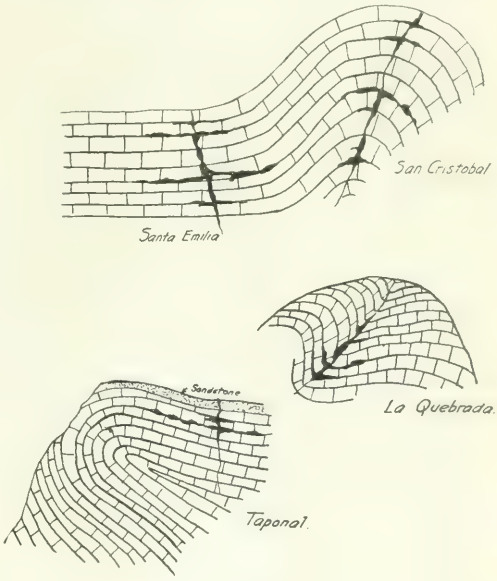


FIG. 19

were differentiated at a late period of magmatic segregation, and discharged in gaseous solution.

At the Cola de Zorra mines of this group, at the northerly end of the district, there has been a striking mineralization of the limestone strata adjoining a narrow belt of sandstone and clay, about 30 ft. thick, in which fossils abound, chiefly small clams. I have traced this fossil horizon south to the Tierras Prietas mines, always immediately above the mineralized strata; however, it is nowhere so clearly defined as at the Cola de Zorra. The photograph (Fig. 17) shows the string of mine openings in the strata immediately below the sandstone. The replacement of lime by antimony is extensive through these strata, vertical fractures showing occasionally as in the Tierras Prietas deposits. The strong twisting to which the whole structure has been subjected, giving heavy folding of the limestones, makes the ore-occurrence very striking, with the sandstone beds on top, the ore-bearing strata below, and a stratum of black, hard, silicious limestone, highly altered, below that, all three formations following the regional folding faithfully. It is quite evident that here, as in the dolomite horizon at

the Mitra or in the lead-iron mines of the Diente, the organic remains contained in the sandstone exercised a precipitating influence on the solutions circulating in their vicinity. It seems equally evident from the testimony of the ore-occurrence in the vertical fractures, with enrichment at the intersections with certain strata and dying out with distance from the fissures, that the solutions and vapors carrying the primary mineral had an igneous origin. With metals so easily volatilized as antimony and the mercury that frequently colors it, it may be assumed that the primary deposition was effected from gases. The comparatively short distance of the deposits from the enormous igneous structure of the Catorce district; the presence of the dikes in the Wadley arroyos, in connection with the important part played by the dikes of Catorce, all point to a regional relation to the Catorce deposits. In the last analysis, the antimony orebodies at Wadley, deposited in cracks made in the strata through the general processes of mountain-making of the area, are to be considered as evidence of dying vulcanism, which in its earlier stages made the lead-silver deposits of Catorce, and originated, like the latter, in the magmatic gases and waters discharged from the igneous rock-mass.

SUMMARY. In the foregoing examples, we have begun by considering true contact deposits, in which the igneous origin of the orebodies can be conclusively demonstrated, and have ended with others in which such igneous origin could only be deduced by analogy; the most striking feature of the study, as a whole, is the practical identity of the ores in the true contact class with those we have just reviewed. This feature seems to me of the greatest importance in its suggestion of a common origin for all these ores.

Steaming Amalgamating Plates

Under certain conditions the removal of amalgam from plates requires a good deal of labor, unless steam is used to soften the deposit. A plate which has a comparatively large amount of amalgam left on it will be capable of receiving a liberal amount of mercury when dressing and will remain soft and in good receptive condition longer than a comparatively bare plate under the same conditions. To preserve this quality such plates will be scraped but lightly, and the result is an accumulation which produces a high steaming-return. The man who adopts this method will obtain a high return by amalgamation, but will probably be accused of holding gold back, and may be reckoned a culprit as far as advocating steaming is concerned. The next example may be taken where a similar condition of plate is arrived at with a minimum of amalgam left. This will require more frequent dressing to prevent hardening, and hard scraping every day; probably also a thorough scouring every other day. This will also give a high amalgamation return with a maximum of labor and the conscious rectitude of a humanitarian who does not advocate steaming. A variety of the foregoing is found where the plan is to scour less often, but make a big job of it once a month, in place of steaming. Another variety of method is adopted by one group where a decrease in mercury consumption is effected by the use of blankets. It is not proposed to go further into methods, because a difference of opinion exists as to whether a high extraction by amalgamation is desirable or not, in view of the labor required and the idle capital involved in laying out the plant.

Variety exists in the ratio of water to rock crushed. On the one hand we have a plant with launders having insufficient grade, where the water-ratio is necessarily high. On the other hand, we have a more modern plant with probably excess launder-grade, but economic in plate-area. In the first case we may have a ratio of perhaps 8:1, and in the second as low as 2:1. These differing conditions will affect the grade of the plant—18% being necessary in the one case compared with 8% in the other. Apart from the overcrowding of the plate-area, this extra grade causes difficulty in control of the plate-condition. With a bare plate there is nothing to arrest the mercury in its tendency to roll off into the launder, so a choice has to be made as to leaving a deposit or very frequent dressing. In any case amalgam at the top of the plate will harden more rapidly and require removal with more labor whether by steaming or by other means. The degree of alkalinity of the mill-water affects accumulations on the plates in that an excess of lime hardens the amalgam. The fineness of the gold amalgamated is also a minor factor; coarse gold particles do not accumulate and are not difficult to remove, but the reverse is true of the finer particles. Dealing with the facts as they are interpreted by S. H. Pearce and T. E. Thomas, according to a statement quoted in the 'Financial Times', steaming can only be considered as a labor-saving device which enables plate-accumulations to be removed with the least difficulty, as otherwise, in the absence of a mechanical device to take its place a large expenditure of labor would be incurred in most instances. In the absence of medical evidence to the contrary, they do not consider, if proper precautions are taken, that steaming should not be continued. The precautions advised are well known to everyone, and are: Provide ample ventilation for plate-houses; lead exhaust-steam from plates to the outside of the building; select men for the operation who are known to be immune; divide the work as much as possible, to avoid over-exertion; provide wash-basins and mouth-washes for the workmen.

MANGANESE ORE assaying 40% has been produced from the Three Kids property near Las Vegas, Nevada. The method of mining the orebody is simple. An overburden from 2 to 12 ft. thick which directly overlies the deposit is broken up and removed by horse-drawn scrapers; the ore is then mined by the open-pit method. The deposit is drilled from the top, and with each round of blasts a great quantity of ore is broken down. The fragments of ore are generally of large size. Large pieces may be handled with little difficulty because of the low specific gravity of the ore, but where necessary the fragments may be reduced by chopping with axes and streaks of sand that adhere to some of the ore may be scraped off with small hand-tools.

The Scope of Work of the Bureau of Mines

By VAN. H. MANNING

Under the organic act establishing it, the Bureau of Mines is authorized to conduct investigations designed to improve health and safety conditions in the mineral industry and to promote efficient development and utilization of our mineral resources. The field of the Bureau's activity, therefore, begins with the commercial development of mineral deposits and ends with the production and utilization of the final marketable product.

In order to serve more efficiently the various sections of the country, the Bureau has established, in addition to its main offices at Washington, D. C., eleven field experiment stations, three field-offices, and several mine-rescue cars and mine-rescue stations. These field-branches are so distributed as to cover most of the mining districts of this country, including Alaska.

The Bureau is prohibited by law from doing work exclusively for the benefit of any private company or individual. Generally speaking, the Bureau does no assaying, ore-testing, or similar service work for the benefit of private companies or individuals. In response to requests for work of this sort a list of assay and ore-testing laboratories is supplied. In referring inquiries to commercial laboratories or consulting engineers, care is taken to mention several names so as to avoid designating any one establishment or engineer.

Samples are frequently brought in to the Bureau stations or received by mail with a request for identification or analysis. If identification requires only a few minutes, the information is furnished by the station; samples for analysis are sometimes referred to the State mining bureau, State university, or similar agency if they are equipped to do such work. An occasional chemical test or determination is made as a matter of courtesy; sometimes the facilities of Bureau laboratories are placed at the disposal of an individual desiring to make some test. These are the exceptions and not the rule, as this interferes with regular work and should be avoided wherever possible. In the matter of furnishing information and professional advice, the stations and field-offices have, in addition to Bureau publications, technical libraries and catalogue-files which are available to the public. The main files of technical information regarding the mining industry are kept in the Washington office. In replying to requests for assistance or advice in regard to developing a property or carrying out some metallurgical experiment or operation, an effort is made to analyze the problem and indicate the scope and character of the work which is involved and the type of professional assistance which is needed. In other words, the endeavor is to suggest the means of obtaining the information or assistance desired. This practice applies particularly to cases where an opinion is desired in regard to a mineral deposit or metallurgical process and where the person making the inquiry has an incorrect impression as to the amount of work involved in a mine-examination or in determining the value of a process for ore-treatment.

Under Bureau regulation, no regular salaried employee is permitted to do private consulting work, except in some cases of arbitration; he is expected to devote his entire time to the work of the Bureau, and in discussing the work of the Bureau staff, therefore, I am considering only the work of the organization.

Apart from certain administrative duties specifically assigned to the Bureau by Congress, the function of the Bureau is regarded as essentially investigative and educational. From this standpoint many of the projects undertaken are in the nature of pioneering; it is expected that some of these which develop favorably will be taken up by private interests and carried forward by them to their ultimate completion or application. In fact the smallness of the appropriation for Bureau work as compared with the field which demands attention, makes it necessary to pursue a general policy of continuing any given activity only so long and to such an extent as is necessary to secure the active interest and co-operation of the commercial organizations or individuals most concerned. In other words, we aim to avoid duplication and, whenever possible, competing in any work that is being effectively handled by any private or governmental organization. This does not mean, however, that the Bureau will not take an active part in matters which are receiving attention from private interests, as in all cases our fundamental purpose is to promote the rapid development of those things which will be of value to the mineral industry.

In the choice of subjects for investigation, the extent to which public interest is involved is a fundamental consideration. The way in which activities may be segregated on this basis can be illustrated by the following diagram:

Governmental activities for benefit of the public		Activities of companies and individuals for private benefit
A. Clear Field	B. 'Twilight Zone'	C. Clear Field
1 Matters of public interest only, no private interest being involved.	1 Matters in which private interest is equal or subordinate to public interest.	1 Matters in which the public has no interest.
2. Matters in which the public interest is paramount to private interest.	2. Matters in which private agencies are not qualified or lack the necessary equipment and which have enough public interest to justify governmental assistance.	2. Matters in which the public does not need to be considered.

An illustration of matter falling in the first sub-division of class A is the testing and inspection of fuel purchases by the Government. The testing of fuel pur-

chased by many branches of the Government is carried on by the Bureau, as the volume of this work makes it possible to carry it on in this way much more cheaply than through the employment of private agencies. For example during nine months of the fiscal year ending June 30, 1920, over 2900 samples involving roughly 38,000 determinations were tested.

As an illustration of work of the Bureau falling in the second group in class A may be mentioned improvements in health and safety conditions in quarries, mines, and metallurgical plants. This subject is a broad one including the work of the mine-rescue cars and stations in training miners in first aid and mine-rescue methods, the testing of explosives and equipment for use underground, the study of vocational diseases among miners, smelter men, etc., the study of mine sanitation, ventilation, and of a considerable number of problems related to safety devices and methods of safe operation underground. In the majority of these problems mining companies have a specific interest. In the nature of the case, however, the solution of these problems involves a study of conditions at many different points. Such a study can rarely be undertaken by any private or consulting engineer.

A number of activities of the Bureau fall in class B. Before citing any specific examples under this heading it may be well to mention briefly certain fundamental requirements which govern the choice of problems for investigation by the Bureau. In the first place the problem must be a real one, involving in its solution something more than mere routine work or the application of well known principles in a field where they have already been applied. In other words it is our aim to take up questions which involve real laboratory or field research and which are beyond the range of the ordinary consulting engineer or commercial laboratory. As a further general requirement a suitable problem should be one common to a branch of the mineral industry or to some mining district. A problem peculiar to a single mine or metallurgical plant, unless presenting some unique feature which might prove of general importance is not ordinarily considered within our field.

Recently the Bureau has carried on quite a little work in co-operation with private companies or individuals. There are two main reasons why this plan of co-operative investigation has been adopted. (1) The financial and other assistance furnished by the co-operative agency make it possible for the Bureau to do more work than would be possible under government appropriations alone. (2) Co-operation on the part of private company or individual in an investigation implies an active interest in the results of the work, and if the investigation turns out successfully, the results can at once be applied in a practical way, thereby leading to more rapid development and to an earlier realization of benefit than would be likely to occur if the investigation had been conducted independently by the Bureau.

There are two ways in which this co-operation is carried out. By one method the Bureau assumes full responsibility for the work, although the major part of the expense is usually borne by the co-operating agency. Work of this sort is undertaken under a formal agreement in which it is provided that all information and data secured shall be available to the Bureau for publication and that any patents arising from the work shall be taken out in this country for the benefit of the general public.

Under the second form of co-operation the Bureau assumes no responsibility for the work, but merely places certain of its facilities at the disposal of a private individual or company with the understanding that the results of all work performed with facilities of the Bureau shall be available to the Bureau.

Generally speaking only subjects which fulfill the general requirements mentioned above will be taken up in a co-operative investigation. The same fundamental purpose applies to co-operative work as to strictly Bureau investigations, namely, the procuring of information which will be of value to the mineral industry.

It is in connection with these co-operative investigations that Bureau work approaches most closely the field of the private company or engineer. In some cases the initiative has come from the Bureau, but more frequently co-operative work has been taken up at the request of an operating company or engineer.

An illustration of a co-operative investigation, the study of the calcination of magnesite to be used in the manufacture of stucco, flooring, etc., may be mentioned. This work is being carried on at the Berkeley station jointly with the Northwest Magnesite Co., which is bearing practically the entire expense of the investigation. A number of other companies engaged in the same industry are also co-operating to the extent of furnishing materials and information, and it is agreed that information in regard to the progress of the work is available to any of these companies at any time.

The advantage from the standpoint of the company lies in securing the use of the laboratory facilities of the Berkeley station and a certain amount of scientific and technical assistance from the staff. From the standpoint of the public, the outcome of this work will be the same as though it were being carried on exclusively with government funds. The assistance of the Northwest Magnesite Co. makes it possible, however, to get on with the work more rapidly than would otherwise be possible.

MANGANESE ORE accounted for 87% of the total quantity of ores exported from India during the fiscal year 1918-'19. The quantity shipped decreased by 11% to 385,400 tons: 77% of the total exports went to the United Kingdom, and the remainder to France, Japan, the United States, Belgium, and Italy. Nearly 10,900 tons of ferro-manganese was exported from Bengal in the year under review. Wolfram ore was shipped entirely to the United Kingdom. The total quantity exported was 4870 tons, of which 4799 tons was from Burma and 71 tons from Bengal. The shipments of chrome-iron ore were 39,100 tons, as against a total of approximately 15,000 tons in 1917-'18.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

CALIFORNIA

FULLERS EARTH TO BE MINED BY ASSOCIATED OIL CO.

SHOSHONE.—The Associated Oil Co. is preparing to ship several hundred tons of fullers earth monthly from one deposit bought from R. J. Fairbanks, and from another leased from the Tonopah & Tidewater Railroad Co., the latter to be paid on a basis of $1 per ton royalty. A. B. Peckham, the engineer in charge, is now in San Francisco conferring with officials of the Associated on the method to be used in mining the material. The beds vary greatly in thickness, but the average appears to be six feet. Mr. Peckham says steam-shovels may be used in removing the overburden and in mining the fullers earth, which will be shipped to Martinez, California, for use in refining lubricating oil. The Standard Oil Co., which secures fullers earth at Ash Meadows, has engineers at Shoshone, but it is not known that this company has bought claims. Mr. Peckham says indications are that the surrounding region contains many useful minerals that have been neglected because prospectors lack knowledge of them. He says the entrance of the Associated into the district caused a rush for claims containing 'soap', as the fullers earth is called at Shoshone, and that everything white was brought to him for examination. The Tecopa Consolidated is shipping 1200 tons of silver-lead ore monthly and is treating 100 tons monthly in an experimental concentrator. The mine is worked through a tunnel cutting the vein at a depth of 1000 ft. The Tecopa company was organized by John T. Overbury, who is now developing the nearby Paddy Pride, a promising prospect. In 1907, Overbury sold control to Nelson Z. Graves of Philadalphia, who built a 17-mile railroad to the mine and started development on a large scale. The manager is L. V. Marshall, who built and now owns the Needles smelter. The Tecopa has been the largest silver-lead producer in California for the last three years. Two tunnels have been driven in the Paddy Pride, the first cutting the vein at a depth of 180 ft. The vein in this tunnel is 10 to 12 ft. wide and two carloads of silver-lead ore have been shipped that gave net returns of $1270 an $1400. There is exposed a 1½-ft. width of ore assaying $138. The second tunnel cut the vein at a depth of 500 ft. and it is being continued to the hanging wall of the vein, on which the ore was found in the upper tunnel. The Silver Rule and Blackwater have been sold by John Chambers to J. J. Jarmuth of New York for $200,000, and the new owner plans to drive a 1000-ft. tunnel. Tonopah men have organized the Death Valley Talc Refining & Manufacturing Co. to develop a huge deposit of talc three miles from the Paddy Pride. Tests have shown the material to be of marketable grade and the success of the company depends on what it will cost to haul the product to the railroad. Men who know the situation of the claims disagree as to whether this can be done.

COLORADO

PORTLAND COMPANY IS SINKING MAIN SHAFT.

CRIPPLE CREEK.—Deep development has been undertaken by the Portland Gold Mining Co., and sinking is now in progress with two shifts at the main shaft on Battle mountain. The shaft, now 2300 ft. deep, is to be sunk an additional 500 ft. and with powerful electric pumps in operation at the Roosevelt Tunnel level, no trouble is anticipated from water. .Ore worth about $1,000,000 has been mined from shoots developed between the 20th and 21st levels and the richest ore in the history of the mine is now coming from the 23rd level. It is estimated that production from between the 21st and present bottom level will reach $2,500,000 in value. In addition to this rich ore, the ore in old stopes near the Portland No. 1 shaft on the south end of the property, is being hauled through the 7th level of the Independence, and 600 tons daily are delivered at the Independence mill. This ore will mill about $3 per ton.

The Ocean Wave Mining Co., that is leasing the Ocean Wave, adjacent to the Portland on the south-west, has resumed production and a car of ore, estimated at 2 oz. per ton, was shipped to the Golden Cycle mill at Colorado Springs recently. The Isabella Mines Co., having failed to secure satisfactory bids for sinking the Empire State shaft, is doing the work on company-account. Lessees on the property continue production.

LEADVILLE.—An orebody opened in the Gertrude in Colorado gulch last fall is again being developed and ore assaying as high as 252 oz. silver, 41% lead, and 2½ oz. gold is coming to surface. Lessees on the property also hold leases on adjacent claims and are extending their work to hold their leases. South of the Gertrude, work has been resumed on the Golden Curry by lessees. The Tiger has been leased and lease-options are reported on the Venture; the Bartlett, Virginius, and Dinero tunnels are under operation by lessees. The Ready Cash tunnel is to be extended by the National Development Co., a Chicago corporation, and the bore is planned to cut the Cora May, Big Chicago, and the Aurora No. 1 and 2

at depth, and explore the veins and dikes traversing this territory. The same company is also operating the St. Kevin of the Parker group held under bond and lease. Work is also in progress on the Collins and Clarke groups in the Red Mountain section and on the Ruby, an old, but rich, producer. Other prospeects are active and in fact more properties are being prospected than for many seasons past.

BRECKENRIDGE.—An electric hoist and compressor is being installed at the Deep shaft on Shock hill by the Deep Shaft Mining Co., recently organized. This shaft, the deepest in the district except the Brooks-Snyder, has reached 700 ft. The property, on account of litigation, has been inactive for 15 years. The power-line of the Colorado Power Co. has been extended to the property. Lessees on the Barger are sinking a new shaft and the owner H. K. Barger, who recently returned from California, is also sinking a shaft west of previous development. Bulkeley Wells, who recently became interested in the Iron Mask, is sinking a deep shaft near the portal of the Iron Mask tunnel and further develpoment is planned.

TELLURIDE.—All machinery for the mill of the Valley View Leasing Co. has been delivered at the San Bernardo mine, the tramway is ready, and, with large tonnage of ore blocked out in the mine, steady production will be made as soon as the mill is completed. A recent assay-test has shown higher gold content in the ore now mined. The plant will start on or about July 10. The Bay State, active 20 years ago, is under examination and it is thought the low-grade silver-lead ore may now be mined at a profit. The Tomboy and Smuggler mills ore operating steadily and shipments of concentrate are going forward.

SILVERTON.—The Gold King mill is operating steadily and turning out two cars of concentrate daily. W. Z. Kinney, manager, has returned from Denver, where the contract for purchase of the Gladstone-Silverton railroad was signed. The mine-output shortly will be increased when transportation facilities are furnished. The West vein, reported 75 ft. wide, is to be explored by a drift at the 700-ft. level, a contract having been awarded local miners by the Pride of the West Mining Co. for 800 ft. of work. The property, a rich producer of the early days, is expected to 'comeback'.

MICHIGAN

STATISTICS FOR MAY.

HEUGHTON.—Arcadian Consolidated has entered good-looking lode material on the 500-ft. level of the New Baltic shaft. The formation is identical in general physical characteristics with the lode uncovered on the 400-ft. level of the same shaft at the time operations were suspended during the War. When work was resumed this spring the shaft was sunk to the 500-ft. level. Drifting has started both north and south, but at this writing has not progressed any great distance. The shaft itself is in the hanging wall, so that there is a distance of 20 ft. to reach the strike from the shaft. The formation is small mass copper. The width of the lode is not yet determined, but there is developed a length of at least 100 ft. The skip-rails have been laid, the timbering completed, and further openings will be made at once. In connection with the present exploration at the New Baltic shaft, it is significant that this shaft is 4000 ft. from the old Arcadian workings, and that the territory between has good possibilities as demonstrated by diamond-drills.

Victoria will become involved in litigation with Gogebic county, if present threats of officials are followed by action. The Victoria mine is situated in Ontonagon county, but the source of supply and outlet of water for its hydraulic compressor is Lake Gogebic. Gogebic county and several residents own land on the shores of Lake Gogebic. When the mining company first began to use the lake-water the level of the lake rose six inches. Recently it has risen six inches in two weeks. The property owners claim that it will rise 60 in. more. They assert that this rise in the water is damaging their property. In recent years the Victoria company has acquired considerable property on the lake shore, but not all of it. The supervisors of Gogebic county are holding a special session this week to determine upon legal action against the company.

The tabulated statement of the output for May 1920 is presented below. Seneca assumes its position among the permanent producers, and all of the larger producers show a decline in refined copper, due to the continued departure of laborers.

	'Rock' tons	Copper content May lb.	Copper content April lb.	Production of refined copper May lb.	Production of refined copper April lb.
Ahmeek	72 000	22.95	26.36	1,652,900	1,700,500
Allouez	21,000	17.48	18	367,100	353,700
Baltic	15.000	36	35	540,000	619,000
Calumet & Hecla	196 831	25	25	4,920,786	5,320,063
Centennial	4,950	13.1	13.4	65,100	90,700
Champion	22,000	45	41	990,000	1,041,400
Isle Royale	44 800	19	18	851,200	1,083,700
Michigan	5 773	24	23.45	138,552	116,350
Mohawk	29 302	29	29.25	849,758	1,071,553
Osceola Con.	44,050	16.7	16.1	739,500	716,200
Quincy	62 000	21	20	1,302,000	1,480,000
Seneca	5 611	30	30	168,330	107,070
Trimountain	9 000	32	32	284,800	374,400
Victoria	5 000	17	17	85,000	84,000
Wolverine	18 879	16.18	17.26	305,603	346,428
White Pine	8 791	21	20	184,625	179,713

MONTANA

NEW WAGE SCALE FOR NEIHART.

BUTTE.—The Tuolumne Mining Co. reports rich silver ore on the 500-ft. level near its Main Range shaft. The discovery is on the Spread Delight vein, it is five feet wide and gives an average assay of 30 to 40 oz. per ton. Specimens taken from this ore run as high as 1100 oz. per ton. The Davis-Daly plans further sinking of its Hibernia shaft. The adjoining Nettie mine is said to have uncovered high-grade silver ore below the present workings of the Hibernia, where the lowest are at 400 feet.

HELENA.—The Lump Gulch mines continue active production and development work. The Little Nell is a consistent shipper of high-grade silver ore, the Free Coinage is making good progress in its sinking operations, while

tunneling and drilling continue at the Muskegon and Mariner mines. Development work is in progress at the Sunset and Baby Helena mines. Operations have been resumed at the King Solomon group.

NEIHART.—The Cascade Silver Mines & Mills, the Neihart Consolidated Silver Mines Co., Flohart Silver Mines Co., and the London company have posted the following notice: "The mine owners and operators of the Neihart mining district will pay the following daily scale of wages: miners $5, teamsters $5, topmen $5, blacksmiths $6, blacksmith's helpers $5.50, carpenters $5.50, engineers (first motion) $6, engineers (gear) $5.50, pipemen $5, station tenders $5.50. Eight hours constitute a day's work. The I. W. W., O. B. U., and the Neihart Metal Mine Workers Union will not be recognized." The Neihart Silver Mines Co. has entered into a partial agreement with the union covering several points. A daily wage scale of $5.50 is being paid as before the strike. The present silver market has served to make the position of the companies a little stronger, while the strikers have been weakened considerably. Many of the single men have left the district since the strike was called.

CUT BANK.—The Black Chief mine has been taken over by local men. Operations on a large scale are planned as soon as a company is organized. Copper is the chief metal, with uranium an important secondary consideration.

CORBIN.—L. S. Roper has leased the property of the Alta-Montana Mining Co. from Costin and Merritt. Cross-cuts will be continued on the 13th level. These cross-cuts are entering the hanging wall of the old Alta vein.

COOKE CITY.—The Republic Mining Co. is shipping machinery for use at its Mohawk property. The equipment includes compressors, engine, and drills. Shipment of ore will be started at once. 2000 ore-sacks to sack the ore mined during the winter have also arrived.

GREAT FALLS.—Control of the Whippoorwill Mining Co. has been secured by F. Wright from Charles Wilkes of New York. The Silver Dyke properties at Carpenter creek are being opened. These properties were recently purchased from Heidenseck & Erickson, and are now under option to a syndicate of New York and Boston capitalists.

NEVADA

UNITED COMSTOCK.—RUBY HILL DEVELOPMENT CO.

CACTUS.—Drifts are being driven on the 265-ft. level of the Cactus Nevada and ore assaying 12 to 15 oz. is being opened. The vein is cut by numerous faults that make it difficult to follow, but it is much less broken than on the upper level. The cross-cut on this level, which was being driven beyond the main vein to the 'south' vein, has been discontinued 100 ft. from the shaft because of the extreme hardness of the rock. Ore assaying 75 to 100 oz. is being broken on the 100-ft. level. This is being shipped.

THE DOROTHY SILVER MINE AT WHITEHALL, MONTANA

ARROWHEAD.—The west drift on the 100-ft. level of the Arrowhead has been advanced 100 ft. from the shaft and for 50 ft. it has been in ore 1½ to 3 ft. wide and assaying $125 to $320. The existence of this ore has been proved 25 ft. below the 100-ft. level in a drift driven from a raise from the bottom level and the grade of ore at this point is similar to that on the 100-ft. level. The shaft is over 250 ft. deep and cross-cutting to the vein will soon be started.

DIVIDE.—The Victory has started shipping to the McNamara mill at Tonopah at a rate of 400 tons per month, but a statement of the value of the ore cannot be secured. The ore, coming from a depth of 350 ft., is reached through a winze from the 200-ft. level, and it is now planned to resume sinking the shaft.

VIRGINIA CITY.—The United Comstock has completed repairs to the Belcher surface plant and repairing of the

shaft has been started. Two shifts of miners are employed in sinking the Imperial shaft from the 400 to the 700-ft. level, and in the other mines of the company work preliminary to starting the haulage-tunnel is under way. The cyanide mill, to be built at a cost of $1,000,000, will have a crushing and grinding capacity of 2500 tons daily, but the other equipment will at first have a capacity of only 1000 tons, which can be increased to handle the output of the entire crushing and grinding-plants as the tonnage is gradually raised to the maximum. The mill will have a gyratory, or Symons disc crushers, ball and tube-mills, Dorr agitators, slime-tables, and precipitation by zinc-dust. It is estimated that the treatment cost will be $1 to $1.25 per ton. The mining cost is estimated at $1.50 per ton.

Eureka.—Eight hundred tons of ore giving a net return of more than $50 per ton has been shipped from a recently found orebody north of the main Dunderberg workings on the 400-ft. level of the Eureka Croesus. A winze has been started to prospect this shoot and several others in the immediate vicinity, and it is planned to reach a depth of 300 ft. below the level. This ore is in territory heretofore unexplored, as the early-day work at this depth in the Dunderberg was done in the south vein. The ore is 8 ft. wide in places and most of the value is in gold. Ore containing 30% copper carbonate has been found at a depth of 700 ft. in the Atlas claim. This ore also assays high in gold and silver. The Prospect Mountain tunnel of the Eureka King is 3200 ft. long and the Eureka tunnel is 2100 ft. long. These tunnels are being driven from opposite sides of Prospect mountain. The Eureka tunnel reaches a maximum depth of 800 ft. and the greatest depth reached by the Prospect Mountain is 1300 ft. The latter is now nearing an important vein in the limestone. Cutting of a pump-station and sump has been started on the 900-ft. level of the Locan shaft of the Ruby Hill Development Co. and unwatering of the shaft to the bottom, at 1200 ft., is to be started in a few days. Shipments are being made from the 900-ft. level. The two 75-hp. semi-diesel engines of the Eureka Holly, one for the hoist and the other for the compressor, are now working, and other important improvements have been completed. It is planned to develop the two main orebodies on a large scale, make connection with the Bullwhacker, where there is a good tonnage of shipping ore broken, and sink the Holly shaft from the present depth of 400 to 700 ft. It is reported that an experimental ore-treatment plant is to be built soon.

UTAH

PARK CITY AND EUREKA ORE SHIPMENTS ARE CURTAILED.

Ophir.—Conditions at the property of the Ophir Silver Mines Co., which recently resumed development work, are most promising, according to Sol Snider, superintendent. An average sampling of a rich streak in the upper claims assayed 173 oz. silver, 5.3% lead, and 7.69% copper. All of the seven main fissures of the district, from which millions of dollars worth of ore has been produced, should cross the property. The company has expended $30,000 in development work, and Snider states that shipping ore of high grade can be developed within ninety days. On the strike of the Buckhorn fissure, which crosses the company's upper claims, and is some 40 ft. wide, with a length of more than 1800 ft., samples have been taken that run from 100 to 1000 oz. silver per ton, besides containing both lead and copper. In the lower working-tunnel, which is now in some 700 ft., a cross-cut has been discovered 75 ft. from the portal and 85 ft. long, which had been run by previous owners in the early days. This cut follows a vein which at its face widened to more than a foot and was strongly mineralized. The company has a force at work in the lower tunnel, another in the upper workings, and a road-building crew.

Park City.—An embargo by the Murray smelter of the A. S. & R. Co. held back shipments from local mines during the week ended June 19 and the preceding week. The embargo is a temporary one, due to labor conditions, which it is believed have now been relieved. The Silver King Coalition was unable to move ore during the week. Shipments totaled 1309 tons, of which the Judge M. & S. shipped 652 tons, the Ontario 501, and the Daly-West 73. The Judge smelter shipped 83 tons of premium spelter during the week.

L. R. Perry, president of the Iowa Copper Co., spent several days here recently. He stated that for more than 15 ft. the face of the cross-cut on the 200-ft. level has been in pyrite, and the expectation is that it will lead to a body of ore. Mr. Perry leased the Mount Masonic property, north of this camp, to Harry Barnicott, who, it is reported, will commence operations in the near future.

Eureka.—Between the embargo still in effect by the American Smelting & Refining Co., and the slump in price of silver, local mines are producing only the minimum amount of ore necessary to keep their organizations intact, with the result that shipments from the district for the week ended June 19 totaled 122 cars, as compared with 143 cars for the preceding week. The Chief Consolidated shipped 36 cars; Tintic Standard, 25; Dragon, 19; Iron King, 8; Mammoth, 6; Iron Blossom, 6; Eagle & Blue Bell, 5; Victoria, 4; Grand Central, 4; Cornucopia, 3; Gemini, 3; Centennial-Eureka, 2; and Colorado, 1. The Tintic Consolidated Mining Co. in the North Tintic district is making preparations to commence work, according to George Nicholes, manager, who has been at the property making the necessary preparations. On account of the scarcity of labor at the present time, it may be late in the summer before development of the ground will be undertaken. A water-line is now being laid to the property. This property adjoins the Lehi-Tintic mine on the north.

The development of the Empire Mines ground through what is known as the 'Lower Mammoth' shaft has been stopped temporarily, according to officials of the Knight interests. This company owns an exceptionally large tract of mineral land in the central part of the district, and during the last few years there has been a consider-

able amount of development, most of it through the Lower Mammoth shaft. Jesse Knight has always had confidence in the Empire Mines, and it is with reluctance that he finally decided that it would be necessary for the present to suspend operations.

Operations by the Dragon Consolidated Mining Co. were suspended on June 20. This action was decided upon by the directors at a meeting held shortly before that date at Provo. There is a market for the iron ore, but there is only a small amount of profit under existing conditions and it is deemed best to hold the ore until such time as it can be made to yield a better revenue. While definite figures are not available, it is generally understood that the iron ore from the Dragon property has been bringing the company about $3.50 per ton, from

BRITISH COLUMBIA

ROAD TO BE BUILT BEYOND PREMIER MINE.

STEWART.—Claims have been located on Fish creek, six miles above Hyder, over which Henry Benson, a resident of Victoria, B. C., and his sons are enthusiastic. They have a good vein and samples taken at the outcrop give returns of $120 per ton in gold, silver, and lead. No trace of zinc is shown. The Bensons have organized a syndicate in Victoria and Vancouver and propose doing development during the summer.

The official announcement that the government of British Columbia plans the building of a road from the Premier mine, to which point there already is a fair road from tidewater, to Joker Flats has been received by

CHIEF CONSOLIDATED MINE AT EUREKA, UTAH

which has to be deducted the cost of mining and freight to Silver City, but not to the smelter. All of the product has been going to the United States smelter at Midvale and to the plants of the American Smelting & Refining Company.

ALTA.—At the Emma property, two teams are hauling ore from the mine-bins to the railroad siding at the Columbus Rexall property. Approximately 1000 tons of ore was accumulated. A new electric air-compressor is being installed at the property, which will be ample for the present needs of the mine. Work on the lower levels has been stopped for the present because of the heavy flow of water, which is about three times the normal quantity. Ore averaging from $85 to $90 per ton has been followed continuously for a distance of 127 ft. on the 500-ft. level of the Woodlawn mine, according to W. N. Lawrence, general manager. A shoot of ore 18 ft. long and 2½ ft. wide, one of the objectives of the drift, has been cut.

mining men with satisfaction. Among the enterprises affected are the Big Missouri, on which work has been in progress for more than a year, and on which it is intended to do some 12,000 ft. of diamond-drilling; Mineral Hill, on which work has been done for two years; the Hercules, which is to be developed this summer; the Silver Tip and Silver Crest, being opened up by Vancouver interests; and the holdings of the Algunican Development Co. The latter company controls through a subsidiary concern, known as the Northern Light Consolidated, a group of claims situated adjacent to the Premier and diamond-drilling thereon is planned for this summer. The same company has the Spider group under option. This property is situated on the west side of Long lake and is equipped with an air-compressor and other machinery.

SHEEP CREEK.—A new concentrating mill, having a capacity of 50 tons per day, has been completed at the Emerald mine by the Iron Mountain, Ltd. This mine has

been one of the steady producers of this section of the Province. During 1917 the mine-run averaged: lead, 27% ; zinc, 5 to 6% ; and silver, 1½ oz. As originally designed the mill was to have a capacity of 30 tons but the addition of an extra set of rolls for the crushing and some alterations in the process, principally in the direction of decreasing the proportion of product sent through the ball-mill, makes it possible to run through 50 tons, while the crushing capacity is 100 tons. The Nugget Mines, Ltd., has its property on a steady producing basis; the Mother Lode mill, remodeled and extended, is in operation. It is giving entire satisfaction. The ore is being taken care of as quickly as it can be brought to the surface.

Nelson.—The annual meeting of the California Mining Co. was held recently at Nelson when it was reported that good progress was being made in the development work under way on the California mine as well as on the installation of new machinery in the Athabasca mill, which is being put in shape for the treatment of the ore. Officers were elected as follows: John R. Cassin, Spokane, president; J. B. Schieger, of La Crosse, Wisconsin, vice-president; W. R. Orndorff, Spokane, secretary-treasurer; John Fraser, Nelson, auditor; W. H. Turner, Nelson, mine superintendent.

Vancouver.—The town of Phoenix will soon be no more. It is gradually being dismantled. The Granby Consolidated Mining & Smelting Co. has a crew of 30 or 40 men dismantling its plant and shipping it to Grand Forks and elsewhere; 20 or 30 cars having been forwarded already. This work will not be finished before August when the Canadian Pacific will remove its steel. The depot now is being taken away. The Great Northern has been busy for the past month removing equipment. Several buildings in the town also are being taken elsewhere.

ONTARIO

HOLLINGER COMPANY ISSUES INTERIM REPORT.

Toronto.—The stamp-tax on the transfer of shares of stock, originally fixed at two cents per share irrespective of the par value, has been modified and fixed at two cents on each $100 face-value of the stock transferred. It is stated that the change was made because there are so many low-priced mining stocks, on which the tax as at first proposed would have represented a large percentage of their value.

Porcupine.—An interim report of an encouraging character has been issued by the Hollister Consolidated covering the period from January 1 to June 2, during which the total income was $2,879,706, compared with $2,822,858 for the corresponding period of last year. The expenditure was $1,448,020, compared with $1,507,060, and the net profit $1,431,685, as against $1,315,798. The average tonnage treated per day showed an increase, being 4056 tons, as compared with 3907. At the annual meeting of the Dome Mines company, held on June 18, it was announced that dividend-payments would be continued at the present rate and that instead of increasing dividend disbursements, surplus earnings would be devoted to the repayment of capital, as the $1,000,000 possessed by the company in cash and bonds gives it all the working capital necessary. Reports as to the closing down of the mine were referred to by C. D. Keading, general manager, who stated that unless the miners quit work or demanded higher wages than they were now receiving there was no intention of shutting down.

Kirkland Lake.—From present indications five mines in the Kirkland Lake district will be producing gold before the end of the year. At present the Lake Shore, Kirkland Lake, and Teck-Hughes are treating an aggregate of nearly 300 tons daily, and producing at the rate of about $115,000 per month. With the Tough-Oakes mill again in operation, and the completion of the Wright-Hargreaves mill, the daily tonnage treated should approximate 600 tons with a monthly output of at least $200,000. The King Kirkland Gold Mines, with an authorized capital of $2,500,000, has been organized for the development of a group of seven claims having an area of 309 acres in the central part of Lebel township. Operations have been begun on a vein which has been uncovered for 150 ft. and contains visible gold.

Skead Township.—This district is attracting increased attention and development is being carried on by a number of companies. The Wisconsin-Skead has installed a mining plant and has done considerable underground work at the 112-ft. level, where some good veins have been tapped by cross-cutting. Diamond-drilling has indicated a series of veins with good gold content. The shaft will be put down to the 300-ft. level. Surface work is being done on the Crawford-Skead, lying west of the Wisconsin. The Fidelity, which owns a group of 10 claims on St. Anthony lake, plans a diamond-drilling program. Many claims were taken up in this area as early as 1906, but the high cost of development and the difficulty of getting in supplies discouraged operations. Now that conditions are more favorable, work may be resumed on many of these properties.

Cobalt.—With United States currency at a premium of around 15% in Canada, the producers of silver in Cobalt are able to market their metal in New York and receive the advantage of payment in American funds. The added revenue from this source alone is about $150,000 monthly. Cobalt mining companies have been approached on the subject of lending their support to two or more oil-prospecting syndicates which propose to carry on exploration work along the Abitibi river at a point less than 150 miles north from Cochrane where members of the Geological Survey announce the discovery of shale in which crude oil is contained. Activity in the South Lorrain silver-area is increasing. The Associated Gold Mines of Western Australia is operating the Keeley mine, and reports having opened a moderate tonnage of medium-grade ore in the lower workings. The company has acquired an option on the adjoining Beaver Lake property and is stated to have found ore extending across the boundary from the Keeley at a depth of about 230 ft. The Haileybury Frontier mine in South Lorrain is also being re-opened.

SALE OF SILVER UNDER THE PITTMAN ACT

For the benefit of the producers of silver ore who sell their product to smelters, samplers, custom concentrators or cyanide plants, or to refiners, the Director of the Mint has revised, with the approval of the Comptroller of the Treasury, the affidavits required in connection with the sale of silver at the rate of $1 per ounce as provided in the Pittman Act. A careful examination of these affidavits will make the conditions of such sales clear. The original producer should furnish the 'Miner's Supporting Affidavit' with each shipment of silver-bearing ore in order that he may get the immediate benefit of the fixed price. In order that the vendor, who is usually a refiner, may realize on silver for which he paid $1 or more per ounce, but which he has had in process for some months, provision is made for ore received at reduction-works since January 17, 1920. The form of the affidavits follows:

AFFIDAVIT BY VENDOR IN CONNECTION WITH PURCHASE OF SILVER UNDER PITTMAN ACT

State of .....)
County of .....) ss.

In order to make a sale of silver to the Director of the Mint in accordance with the provisions of the Pittman Act approved April 23, 1918, the undersigned hereby represents and certifies under oath that he is the ..... of
(Title of office)

....., owner of certain silver to the amount
(Name of vendor)

of ..... fine ounces more or less, forwarded to the United States Mint at ..... on the ..... day of ..... 1920, and delivered for sale to the Director of the Mint under the provisions of said Act for account of said vendor; that said silver is the product of mines situated in the United States and of reduction-works so located, being either (1) wholly without admixture of the product of foreign mines or reduction-works, or (2) part of a mixture of foreign silver and domestic silver delivered to domestic reduction-works since January 17, 1920, and within the proportionate part of such mixed product which represents the product of mines located within the United States and of reduction-works so located, delivered by such mines to such reduction-works since January 17, 1920, after taking into account sales heretofore made to the Director of the Mint under said Act; and that the vendor will forthwith file with the Superintendent of said Mint such statements and exhibits from its books of account and also such supporting affidavits and sworn statements of exhibits by itself and by the miner, smelter, and refiner, as may be demanded by the Director of the Mint under said Act.

.....
(Signature of vendor or duly authorized officer)

Subscribed to and sworn to before me this ..... day ....., 192...

.....
Notary Public.

MINER'S SUPPORTING AFFIDAVIT

State of .....)
County of .....) ss.

The undersigned, being duly sworn, deposes and says: That he is the ..... of .....
(Title of officer) (Name of mine owner)

owner of the ..... mine, situated in the County of .....
(Name of mine)

....., State of .....; that the said .....
(Name of mine owner)

has sold and delivered to ..... on the ..... day of ..... 1920, at its smelting plant known as the ..... smelter, situated in the County of ..... State of ....., ... fine ounces of silver, which was produced at the said mine located as aforesaid and contained in certain parcels of ore as described in settlement or liquidation sheet No. ..... of said ....., and that said silver was paid for at the rate of not less than $1 per ounce, adjusted to the equivalent price of silver 999 fine and to the cost of delivery refinery to mint.

.....

Subscribed and sworn to before me this ..... day of ..... 1920.

.....
Notary Public.

COLORADO

Denver.—The dates for the first-aid and mine-rescue contests which, in a way, will be international in their scope, in that miners of Canada and Mexico, as well as those of the United States, will be invited to participate, has been changed to September 9, 10, and 11. Contests were held at Pittsburgh last year and teams from Colorado, Montana, and Washington were represented. The meet is held under the auspices of the Bureau of Mines.

Mayday.—Lon Wigmore and associates have secured a lease on the Lucky Moon and have started a tunnel to cut a vein along a fault where some good ore was mined a few years ago.——It is reported that lessees have taken over the Mountain Lilly, situated above La Plata, and have begun work there. This property, it is said, has produced a small amount of ore, but has been idle for some time.——Thomas Welborn and Joe Clark are making an examination of the Tomahawk, with a view to taking a lease. They are also working the Idaho dump, and have shipped two cars of ore which assayed $40 per ton.——Wm. Grafiin has a force of men at work on the Copper Queen.

IDAHO

Twin Falls.—Arrangements are being made for the erection of a 100-ton mill at the Buhl-Jarbidge mine at Jarbidge. This announcement is made by J. C. Deemer, general manager of the property, who says the work will begin as soon as roads to the mine are in condition to use, which should be in about a fortnight. Power-drills, it is expected, will be in operation not later than September 1. Mr. Deemer states that the Windy vein, where it outcrops on top of the mountain, is only eight inches wide, while 640 ft. below the sur-

face, in the tunnel, this vein is 17 ft. wide, assaying $12 per ton.

MINNESOTA

Duluth.—Further curtailment of mining work on the iron-ranges, due to shortage of coal as well as boats to take ore from the docks, is reported in many sections. Range-pits that increased the number of shovels at work recently have been again forced to reduce operations to a minimum. Shipping has been almost entirely discontinued and other work is being regulated by transportation facilities.

MISSOURI

Joplin.—A record week's output of zinc has been made by the Chanute Spelter Co. from its mine one mile west of Baxter Springs. In six working days of 24 hours each the output was 458 tons of zinc and 14 tons of lead. The next highest record in this district was made by the Skelton mine near Douthat, which produced in one week 438 tons of zinc. Production figures for the district are: blende, 18,462,880 lb., $408,358; calamine, 459,660 lb., $8050; lead, 2,009,730 lb., $145,300; total value, $561,708. Average value per ton, blende, $44; calamine, $35; lead, $100. Twenty-four weeks: blende, 534,571,640 lb., $13,550,487; calamine, 8,984,620 lb., $170,039; lead, 90,478,000 lb., $4,781,065; total value, $18,501,613.

Beer, Sondheimer & Co., of New York, have brought suit in the Supreme Court against National Zinc Co , to recover $873,342, alleged to be balance due plaintiffs for advances at different times to the Zinc company. It is alleged that demand for payment of balance alleged due was made June 1 and was refused.

UTAH

American Fork.—Operations at the Globe mine in American Fork canyon are being pushed steadily, according to John Cleghorn, manager. From four to six feet of progress per day is being made in the drift along a north-south fissure to its intersection with an important vein about 150 ft. ahead. At present the formation is well mineralized, with bunches of carbonate ore appearing at intervals.——W. S. Cool, of Salt Lake City, owner of the Sierra patented claims, has been here recently, arranging to start work on his property. These claims adjoin the Miller mine, a big producer in early days.

Vernal.—The Jeannette Copper Mining Co. will resume operation of its property in the Uinta basin about July 15, according to Wm. O'Neil. The mine has been idle since 1916. The property consists of 34 unpatented claims, situated about 35 miles south of Rock Springs, Wyoming, the nearest railroad point. Development consists of approximately 1000 ft. of tunnel and shaft-work. It is stated that some rich copper ore has been developed, which the company will start mining and shipping.

Santaquin.—The Union Chief Mining Co. will ship three cars of high-grade lead-silver ore from its mines, according to Alfred Larson, superintendent. The company has recently completed work on a road from the mine to the railway, a distance of three miles. Ore showings in the mine continue to improve, and a fair amount is being taken out from development work.

WASHINGTON

Northport.—An orebody on the line of the Gladstone and Electric Point mines, opened in the Gladstone to a depth of 50 ft., has been cut by the Electric Point in a cross-cut at a depth of 145 ft. At the new point it is on both sides of the line. It contains lead in carbonate and sulphide form. The Gladstone has opened six chimneys, four within recent weeks. The sixth has been followed by a shaft to a depth of 43 ft. and is said to contain carbonates and some sulphides. The last carload weighed more than 43 tons. The ore contained 78.4% lead and the gross value was $4272, of which $4 per ton was in silver.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

H. S. Denny is returning to London from Montreal.

S. E. Bretherton has gone to Seattle and Vancouver.

F. Le Roi Thurmond is at Santa Barbara, Chihuahua.

Fedor F. Foss, of New York, is at Rockville, Maryland.

Arthur Feust is with Hughes & Dies, at 42 New St., New York.

J. H. Forman, of Tonopah, Nevada, has moved to San Francisco.

J. B. Annear has moved from Panaca, Nevada, to Merced, California.

Philip Wiseman, of Los Angeles, is in New York, on his way to London.

William Compton has moved from Fairfield, Idaho, to Virginia City, Nevada.

Warren D. Smith is returning to the Philippines as Chief of the Division of Mines.

Conway G. Williams has changed his address from Ajo, Arizona, to Garfield, Utah.

Edwin E. Chase, of Denver, has gone to Wyoming to examine some copper mines.

Charles E. Prior Jr. is engineer with the Premier Gold Mining Co. in British Columbia.

G. O. Murray is still at Asanboni, India, being unable to go to London as he had intended.

M. J. Weller, superintendent of the Greenhorn mine in Shasta county, is in San Francisco.

R. C. Warriner, formerly general manager of the Crown Mines, on the Rand, is visiting California.

Alan M. Rodgers, of Washington, D. C., is now with the Moctezuma Copper Co., at Nacozari, Mexico.

Lewis A. Levensaler has opened offices as consulting mining engineer at 902 Hoge building, Seattle.

O. F. Brinton, general manager for the Western Utah Copper Co. at Gold Hill, Nevada, is in New York.

Clarence A. Wright, of the Salt Lake City station of the U. S. Bureau of Mines, has gone to Trentino, Italy.

Alfred Hunt has been appointed superintendent for the Angels Camp Deep Mining Co., at Angels, California.

Homer Guck, for the past 15 years editor of the 'Daily Mining Gazette' at Houghton, Michigan, has resigned.

Alan M. Bateman, professor of economic geology, at Yale University, has gone to British Columbia and Alaska on professional business.

L. T. Buell has taken a position with the Phelps Dodge Corporation at Douglas, Arizona, after having spent several years in South America.

Horatio C. Ray has resigned his position with the School of Mines, University of Pittsburgh, to become connected with the Keystone Consolidated Publishing Co., at Pittsburgh.

Glen D. Cook, mining engineer of Salt Lake City, who has been operating the Montezuma and Jersey mines in Pershing county, Nevada, has organized the Pershing County Mines Co.

H. Hardy Smith arrived in San Francisco on June 23 on the 'Tenyo Maru' from Korea on his way to New York, where he will remain three weeks. He will return to San Francisco before sailing for Australia.

R. Allison Purvis, of London, arrived on June 23 in San Francisco on the 'Tenyo Maru' from the East, having escaped from the Bolshevists in Siberia, where he was imprisoned by them from January until April at Krasnoyarsk, Irkutsk. He will sail for London from New York on the 'Mobile' on July 10.

THE METAL MARKET

METAL PRICES

San Francisco, June 29

Aluminum-dust, cents per pound	65
Antimony, cents per pound	10 50
Copper, electrolytic, cents per pound	19
Lead, pig, cents per pound	8.25—9.25
Platinum, pure, per ounce	$85
Platinum, 10% iridium, per ounce	$118
Quicksilver, per flask of 75 lb.	$85
Spelter, cents per pound	9 25
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

June 28.—Copper is inactive but steady. Lead is dull but steady. Zinc is quiet and firm.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid $1 per ounce for all silver purchased by it, fixing a maximum of $1.01½ on August 15, 1918, and will continue to pay $1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine) calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
June 22	93.00	52.50	May 17	101.21	58.50
" 23	92.50	51.62	" 24	100.12	58.52
" 24	90.00	51.25	" 31	101.17	58.87
" 25	90.00	51.25	June 7	98.23	56.52
" 26	90.00	50.50	" 14	86.00	48.02
" 27 Sunday			" 21	87.07	48.73
" 28	93.00	53.00	" 28	91.41	51.69

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	....
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	....
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	....	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
June 22	19.00	May 17	19.00
" 23	19.00	" 24	19.00
" 24	19.00	" 31	19.00
" 25	19.00	June 7	19.00
" 26	19.00	" 14	19.00
" 27 Sunday		" 21	19.00
" 28	19.00	" 28	19.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	....
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	....
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19.33	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	....	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
June 22	8.15	May 17	8.50
" 23	8.15	" 24	8.50
" 24	8.15	" 31	8.50
" 25	8.15	June 7	8.68
" 26	8.15	" 14	8.75
" 27 Sunday		" 21	8.21
" 28	8.15	" 28	8.15

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	....
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78	....
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	....
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.88	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	....	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	....
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	....
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	....	Dec.	71 52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
June 22	7.80	May 17	8.11
" 23	7.85	" 24	7.96
" 24	7.85	" 31	7.92
" 25	7.85	June 7	8.02
" 26	7.85	" 14	8.00
" 27 Sunday		" 21	7.79
" 28	7.90	" 28	7.85

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	....
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	....
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	....	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date			
June 1	80.00	June 15	85.00
" 8	90.00	" 22	85.00
		" 29	85.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	....
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	....
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	....
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120 00	78.00	....
June	112.00	94.40	....	Dec.	115.00	95.00	....

FOREIGN EXCHANGE

Discussing the improvement in sterling exchange, the Anglo-South American Bank of London analyzes the situation as follows: "In case of countries whose currencies are at a discount as compared with ours, there has been a fairly general contraction in the premium on sterling the past month or so, this improvement being particularly marked in the German quotation. Premium on sterling as compared with marks has fallen since the end of January from 1686% to 69%, while in case of Paris the present premium in sterling of about 102% compares with 170% two months ago.

"This recovery in value of depreciated foreign currencies compared with sterling, however, has not had any adverse effect on the position of sterling as compared with markets in which British currency is at a discount. In New York, discount on sterling is now about 20%, against 31% in February, the extreme mark during the present year, and in most other markets in this group the experience has been the same. Presumably London, which previously was affected by its own indebtedness to New York, and indirectly by indebtedness of other countries for which it acted as intermediary in exchange transactions, is now benefiting not only from improvement in our own exports but from the better trade position being established by certain continental countries.

"How substantial has been the improvement in European trade position as against the United States the following figures show. During April value of United States shipments to Europe declined $135,000,000 compared with April of last year, but imports from Europe increased $68,000,000 and practically $700,000,000 for 10 months to April 30. Figures of United States exports to this country showed substantial reduction, and corresponding imports almost as substantial an increase, while in case of France, also, marked improvement is shown, value of French exports to United States for 10 months being $145,000,000, against less than $45,000,000 the preceding year, while during the same period French imports from United States declined just over $200,000,000. It is true the balance of trade is still heavily in favor of America, but all evidence goes to show Europe has appreciated the need for lessening of consumption and increase in production, and is acting accordingly.

"In these circumstances, improvement in the European exchanges as compared with the dollar is only natural, but the position has also been affected by definite decision of the British and French governments to repay the $500,000,000 Anglo-French loan at its due date in October next, by heavy gold shipments made to the States on this account, and also by large sales of government-owned wool, while another factor of more temporary character but of considerable importance is the definite postponement until 1922 of interest payments on our debt to the American government. This was disclosed by Austen Chamberlain in answering a House of Commons question on May 5, and incidentally he stated that approximately £23,000,000 was included in the debt charge for the current financial year in respect of interest on debt raised outside the United Kingdom, but that the amount due from this country to the American government alone would, at par of exchange, amount to £43,000,000 per annum."

MONEY AND EXCHANGE

Foreign quotations on June 29 are as follows:

Sterling, dollars:	Cable	3.95⅜
	Demand	3.96¼
Francs, cents:	Cable	8.40
	Demand	8.43
Lire, cents:	Demand	6.01
Marks, cents		2.75

Eastern Metal Market

New York, June 23.

There is still an absence of demand for practically all the metals and prices of some have fallen.

Demand for copper is very light but prices are steady.

While buying of tin is light, values have been advancing and the market is fairly strong.

Lead has declined quite decidedly and there is no urgent demand.

The zinc market is still lifeless and prices are lower.

Antimony is a little easier.

IRON AND STEEL

Iron and steel producers are still traveling in a circle, betterment in car and fuel-supply being quickly followed by a return of old conditions, says 'The Iron Age'. This week the breaking out of fresh railroad strikes at Philadelphia and Baltimore has crippled several Eastern steel-plants, and embargoes against the affected districts have been put in force at Pittsburgh.

Fuel-shortage has driven some pig-iron producers to pay new high prices for coke and $17 has been reached in the dizzy ascent of that market. Basic pig-iron also tends higher. On the other hand are easier prices in plates and shapes; but with little promise of better than 75 or 80% production for many weeks, no significant readjustment of finished steel prices is looked for.

The buying of steel cars by steel and coke companies goes on. In the past week such new inquiries involved 2700 cars and one car-works took orders for 1500.

The possibility of a sheet and tin-plate shut-down on June 30 has led to recent re-sales of sheet-bars, some bessemer bars having been offered at $65 to $70 and open-hearth bars at less than $75, representing some easing-off.

A new development in the coke market is the inquiry coming from South American and European sources, including one for 10,000 tons per month for 18 months. Owing, however, to the shortage in this country and to the high prices, it is not expected that exports will be heavy.

COPPER

There is no change in the general situation—at least not for the better. A fresh outbreak of 'outlaw' railroad strikes in the East is not an encouraging sign, particularly in the Baltimore territory where there are large refinery interests. It may be necessary to shut-down one or two refineries there should the matter grow worse. Demand is very light and prices as a result are largely nominal. Large producers continue to quote 19c., New York, for both Lake and electrolytic for early delivery and see no reason to change. Small producers and some outside interests are quoting as low as 18.25c., New York, for electrolytic for early delivery. The large interests are booked up well ahead but difficulties of various kinds are limiting output and shipments.

TIN

There has been a gradual advance in the quotation for spot Straits, New York, and it is believed that the low level was reached last week at 45.50c. Yesterday the quotation was nominal at 50c., New York. The higher trend is due largely to a strong London market. Yesterday spot Straits in London was quoted at £270 per ton. In the week on this side the market has been quiet on the surface but a fair record in sales has been made. These have been participated in largely by dealers though consumers have done a little buying. One large consumer inquired last week Thursday for 200 tons which is understood to have been closed. On Wednesday last week, on the New York Metal Exchange, sales of 225 tons were recorded as well as 50 tons on Tuesday. Of the 225 tons on Wednesday, 200 tons was Straits tin for July shipment and future shipment from the East, all at 45 to 45.25c. There was a 25-ton lot of Chinese tin which was sold at 42.12½c., the sale being forced because of the failure to protect a margin, according to reports. Last Saturday there was an active demand for future shipment but there was a lack of sellers, not much business being done at bids of 47.75 to 48c. With London advancing, a buying-movement on this side is expected soon. Arrivals of the metal to date this month have been 2695 tons with 4430 tons reported as afloat.

LEAD

A dull market here for several weeks as well as the slump in London a week ago have been the causes of two sharp reductions in prices. Late last Tuesday, June 15, the American Smelting & Refining Co. reduced its quotation ½c. to 8c., St. Louis, or 8.25c., New York, and then on the next day repeated the operation, making the level 7.75c., St. Louis, or 8c., New York, for early delivery. The outside market, which had been above the Trust price for some time, met this and is now quoted at around 7.90c., St. Louis, or 8.15c., New York. The fear of imports of the metal is also alleged as a cause for these reductions. It is a fact that lead is not plentiful for spot delivery or for early shipment from the West, neither is there any urgent demand.

ZINC

Extreme dullness still characterizes this market. There is no extensive buying and the general basic conditions mentioned last week still prevail. Values fell to lower levels late last week when 7.35c., St. Louis, for prime Western prevailed, but since then there has been an advance, due to a higher London market. Today prime Western is quoted at 7.45 to 7.50c., St. Louis, or 7.80 to 7.85c., New York. Producers are still inactive sellers and are only taking care of customers' immediate needs. Galvanizers are not active buyers, due to the uncertainty of the future.

ANTIMONY

The market is dull and inactive. The metal is quoted at 7.75c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

Quotations are unchanged at 33c., New York, from the leading interest and 31.50c. from other sellers for wholesale lots for early delivery.

ORES

Tungsten: There are no transactions recorded and the market is flat. The last quotation, which was nominal, was $6.50 per unit for Chinese ore with other grades correspondingly higher. Until general business conditions improve no life to the market is likely.

Ferro-tungsten is unchanged and nominal at 85c. to $1.15 per lb. of contained tungsten.

Molybdenum: This market is also dead with quotations nominal at 60 to 65c. per lb. of MoS_2 as the foreign quotation and 75c. as the local.

Manganese-Iron Alloys: There continues to be an absence of inquiry for both prompt and last-half delivery. Prices are firm at $225 to $250 for prompt and $200 for last half. The only inquiries are about 300 tons for last half. Spiegeleisen is firm at $75, furnace, but the market is quiet.

Kerosene export quotations in New York have declined twice since June 1. A drop on June 7 from 15c. to 14.25c. per gallon for standard water-white, in bulk, was followed by a second on June 12, from 14.25c. to 13.50c.

Book Reviews

Structural Drafting and the Design of Details. By Carlton Thomas Bishop. Pp. 338, ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $5.

This is a textbook for students and apprentices and a reference book for structural draftsmen. It is divided into three parts. Part I is introductory and gives a general discussion of the organization of a structural-steel company and of the manufacture and fabrication of structural steel. Part II is devoted to drafting-room practice. The discussion is complete, from the mechanical details of the use of tracing-cloth and ink-erasers to the laying out of beams, girders, and columns. Part III deals with the design of details in a similarly thorough manner. An appendix contains the usual data regarding properties of standard structural shapes as well as a number of other tables and diagrams useful in this class of work.

Manual for the Oil and Gas Industry. By Ralph Arnold, J. L. Darnell and others. Pp. 176. Ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $2.50.

Whatever we may think of the various provisions of the internal revenue laws relating to corporation taxes, the fact remains that corporations must make returns under these laws. The present volume was originally issued as a bulletin of the Internal Revenue Bureau, and is designed to assist members of the accounting departments of companies producing oil in making the calculations necessary for preparing the proper tax return. The scope of the book is indicated by the titles of the various chapters, which are Amplification of the Law and Regulations, Estimate of Depreciation of Equipment, and Estimate of Recoverable Underground Reserves of Oil. While the book, as already noted, is primarily designed for those preparing Federal tax returns on behalf of oil companies, it will be useful to anyone interested in the valuation of oil properties.

Text-book of Inorganic Chemistry. Vol. IX. Part I. By J. Newton Friend. Pp. 366. Index. Charles Griffin & Co., London. For sale by 'Mining and Scientific Press'. Price, $6.

The general plan of this series has been to devote one volume to each of the groups of elements according to the periodic classification. In this instance iron has been treated separately in Part II so that this particular book deals only with nickel, cobalt, and the palladium and platinum groups. For the research student, as the author points out, fuller details are necessary than can be included in a textbook of this scope. Accordingly copious references are given to the original memoir. While the past two decades have marked rapid strides in the development of the chemistry of the metals and their compounds, there is still a deal of unchartered territory yet to be explored. This work is new and is based upon the present state of our knowledge of inorganic chemistry. The book is of course designed for the use of the student and for that purpose it is well adapted. It appears to be comprehensive, clear, and well arranged.

Forge Practice and Heat-Treatment of Steel. By John Lord Bacon. Third edition. Pp. 407. Ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $1.75.

The author of this book was for some time instructor in forge practice at the Lewis Institute at Chicago, and the text is based on notes prepared for courses given there. In the third edition the subjects of hardening, tempering, and annealing are treated at considerably greater length than in the previous editions. The first chapter is devoted to a general description of the blacksmith's forge and tools. Welding in the forge is next discussed, and then the making of all kinds of hand forgings, including the calculation of stock, and the methods of actually doing the work. Steam-hammer work is then considered, also the use of dies to produce duplicate parts. The remainder of the book is mainly devoted to tempering, hardening, annealing, and casehardening, and discusses both the equipment used and the methods of doing the work. The treatment is non-technical and practical throughout, theoretical discussion being eliminated as far as possible. It will be of value not only to the apprentice and mechanic but also to the engineer who either uses or has charge of the manufacture of forgings.

The Mines Handbook. By Walter Harvey Weed. Pp. 1976. W. H. Weed, New York. For sale by 'Mining and Scientific Press'. Price $15.

The latest issue of this valuable publication is just to hand. It covers the years 1918, 1919, and the first quarter of 1920. Much of the information is brought down to April of the current year. The present volume contains 70 pages more than that issued in 1918, and the number of companies listed has increased by 1000, making the total 7400. It would be well if all the advertisements could be placed at the back of the volume; also the index. The geographical arrangement by countries, States, counties, and districts is advantageous. As usual, the volume contains a glossary and a brief description of the principal copper minerals. It is evident that there has been some difficulty in getting information concerning certain mining enterprises, but this is the usual experience of statisticians and compilers of industrial data. As this volume becomes a public institution, it ought to receive increasing support, not only by its sale but also by a greater willingness on the part of mining companies to assist the editors by giving them the needed information. The new districts, in Nevada and British Columbia, for example, are creditably complete. Consolidations, absorptions, and liquidations are carefully recorded. No less than 460 pages are devoted to mining companies in foreign countries, particularly those to which American energy and capital are being diverted. The collection of geologic and metallurgic data gives technical value to the volume. The various statistical tables have been brought up to date. This handbook is the successor to the one started by Horace J. Stevens in 1900. It is fortunate that a man so well informed as Mr. Walter Harvey Weed should have taken up the work when Stevens died. We are frank to say that we find the 'Mines Handbook' of great use to us in our editorial work, and we can surmise how useful therefore it must be to others requiring prompt information concerning the organization, personnel, and production of mining companies in various parts of this country and also abroad. It is extremely difficult to compile so large a mass of information without introducing errors, but the marvel is that there are so few. Without question, the 'Handbook' is performing a highly useful function, and we hope that Mr. Weed's enterprise will meet with public support.—T. A. R.

Engineering for Land Drainage. By Charles G. Elliott. Pp. 353. Ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $2.50.

This is the third edition of a book which, appearing originally in 1902, has come to be regarded as a standard treatise on the subject. Comparing it with the second edition, we find several changes and additions, including a revision of the discussion of the hydraulics of flow in underdrains, new tables for computing the discharge of tile-drains, and additions to the discussion of drainage by pumps and of drainage of irrigated lands.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

THE SELECTION AND TREATMENT OF TRANSMISSION BELTS

By E. J. Black

The right and wrong ways of lacing belts are shown in the accompanying illustrations. The top and bottom views show a belt which has been properly laced. The holes were punched evenly and the lacing was done smoothly, leaving no loose ends which might catch and injure the belt. The middle view shows a belt improperly laced. The holes were punched in some instances so close together that the lacings tore through. A belt laced like this cannot be expected to give the maximum amount of service. The following detailed instructions as to the proper way of lacing may well be studied.

(1) Cut the ends of the belt absolutely square. Do not depend upon your eye or use an ordinary ruler. If the end is slanted in the least degree all the pull will come on one side of the belt and the consequences are likely to be disastrous. (2) Make the holes as small as practicable. Use an awl rather than a punch, wherever possible. (3) Leave a sufficient margin at the edge of the belt without holes so as not to impair its strength. In belts 2 to 6 in. wide, the holes should not be nearer to the edge than ½ in., in belts 6 to 12 in. wide not nearer than ⅝ in., and belts 12 to 18 in. wide not narrower than ¾ in. (4) Make two rows of holes, in parallel lines straight across the width of the belt, and stagger the holes, so that the strain comes upon different portions of the belt. (5) Be sure that the holes in the two ends to be joined match exactly. Otherwise there will be a 'jog' in the belt, and this is likely to result in tearing the belt lengthwise. (6) Use flexible lacing, being careful to have it proportionate to the size of the belt. A heavy lacing is likely to cause trouble. (7) In lacing the belt, make the pulley side as smooth as possible. Rough places and ends should be turned away from the pulley. (8) In using metal fasten-

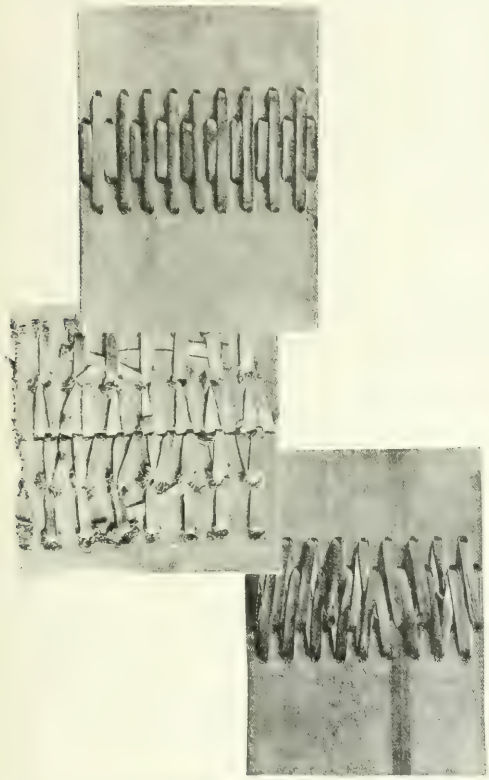
Table for Finding the Horse-Power of a Belt

Speed in feet per minute

Width	Ply	200	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
4″	4	1.45	3.64	7.27	10.9	14.5	18.2	21.8	25.4	29.0	32.7	36.4	40.0	43.6
	5	1.82	4.55	9.1	13.6	18.2	22.7	27.3	31.8	36.4	40.9	45.4	50.0	54.6
	6	2.18	5.45	10.9	16.4	21.8	27.3	32.8	38.2	43.6	49.0	54.5	60.0	65.5
5″	4	1.82	4.55	9.1	13.6	18.2	22.7	27.3	31.8	36.4	40.9	45.4	50.0	54.6
	5	2.27	5.68	11.4	17.1	22.8	28.4	34.1	39.8	45.5	51.1	56.8	62.5	68.2
	6	2.73	6.83	13.6	20.5	27.2	34.1	41.0	47.8	54.5	61.4	68.2	75.0	81.8
6″	4	2.18	5.45	10.9	16.4	21.8	27.3	32.8	38.2	43.6	49.0	54.5	60.0	65.5
	5	2.73	6.83	13.6	20.5	27.2	34.1	41.0	47.8	54.5	61.4	68.2	75.0	81.8
	6	3.28	8.18	16.4	24.6	32.8	40.9	49.1	57.3	65.5	73.7	81.8	90.0	98.2
8″	4	2.91	7.27	14.5	21.8	29.1	36.4	43.7	51.0	58.2	65.5	72.7	80.0	87.3
	5	3.64	9.1	18.2	27.3	36.4	45.5	54.6	63.6	72.7	81.9	91.0	100.0	109.2
	6	4.37	10.9	21.8	32.7	43.6	54.5	65.5	76.4	87.3	98.3	109.0	120.0	131.0
10″	4	3.64	9.1	18.2	27.3	36.4	45.5	54.6	63.6	72.7	81.9	91.0	100.0	109.2
	5	4.55	11.4	22.7	34.2	45.5	56.9	68.3	79.5	91.0	102.2	114.0	125.0	136.4
	6	5.46	13.65	27.3	40.9	54.5	68.2	81.8	95.5	109.0	122.6	136.4	150.0	163.6
12″	5	5.46	3.65	27.3	40.9	54.5	68.2	81.8	95.5	109.0	122.6	136.4	150.0	163.6
	6	6.55	16.3	32.7	49.1	65.5	81.7	98.2	114.4	130.9	147.0	163.5	180.0	196.0
14″	5	6.36	15.9	31.8	47.7	63.6	79.5	95.5	111.4	127.2	143.0	159.0	175.0	191.0
	6	7.64	19.1	38.2	57.3	76.4	95.5	114.6	133.8	152.8	172.0	191.0	210.0	229.2
16″	6	8.73	21.8	43.6	65.5	87.3	109.0	131.0	152.7	174.6	196.5	218.0	240.0	262.0
	8	11.63	29.1	58.2	87.3	116.3	145.3	174.6	203.5	232.6	262.0	290.6	320.0	349.2
18″	6	9.82	24.5	49.1	73.7	98.2	122.8	147.4	171.8	196.4	221.0	245.6	270.0	294.8
	8	13.09	32.7	65.4	98.3	130.9	163.4	196.6	229.0	261.8	294.0	326.8	370.0	393.2
20″	6	10.9	27.3	54.5	81.8	109.0	136.5	163.6	191.0	218.0	245.6	273.0	300.0	327.2
	8	14.5	36.4	72.7	109.0	145.5	181.9	218.0	254.5	291.0	327.7	363.8	400.0	436.0
24″	6	13.09	32.7	65.4	98.3	130.9	163.4	196.6	229.0	261.8	294.0	326.8	370.0	393.2
	8	17.4	43.6	87.2	130.8	174.4	218.0	261.6	305.0	348.8	392.0	436.0	480.0	523.2
30″	6	16.3	40.8	81.6	122.4	163.2	204.3	245.0	286.0	326.4	368.0	408.6	450.0	490.0
	8	21.8	54.6	109.0	163.8	218.0	272.8	327.6	382.0	436.0	492.0	545.6	600.0	655.0
30″	10	27.3	68.2	136.4	204.6	273.0	341.0	409.2	477.4	546.0	614.0	682.0	750.0	818.4
36″	8	26.2	65.5	131.0	196.5	262.0	327.5	393.0	458.0	524.0	589.0	655.0	720.0	786.0
	10	32.7	81.8	163.6	245.4	327.2	409.0	490.8	573.0	654.4	737.0	818.0	900.0	981.6
42″	8	30.5	76.4	152.7	229.2	305.4	382.0	458.4	535.0	610.8	687.0	764.0	840.0	916.8
	10	38.2	95.5	190.9	286.5	382.0	478.0	573.0	668.0	764.0	860.0	956.0	1050.0	1146.0
48″	8	34.9	87.3	174.5	261.9	349.0	437.0	523.8	612.0	698.0	786.0	874.0	960.0	1047.6
	10	43.6	109.0	218.0	327.0	436.0	546.0	654.0	764.0	872.0	982.0	1092.0	1200.0	1308.0

ers select those which place the strain on the length-wise strands of the belt. The cross-wise strands are not as strong as those which run length-wise.

Besides improper lacing, there are many other abuses which shorten the life of belts. Shafting that is out of line may cause an undue strain upon the belt and make it run off the pulley. Oil may be allowed to drip upon the belt and ruin it. The belt may be applied with an initial tension so great as to produce an unnecessary strain. Many complaints regarding unsatisfactory belt performance can be traced to the fact that the wrong belt was used on the job. No matter how good a belt is or how good treatment it receives it



Correct and Incorrect Methods of Lacing Belts

will fail to give satisfactory service if not adapted for the use to which it is put.

In deciding upon the right belt for any particular service there are eight factors to be considered: (1) distance between pulley centres; (2) diameter of the pulleys; (3) width of the pulleys; (4) use of idlers, cone pulleys, quarter turn, half turn, etc.; (5) speed; (6) horse-power to be transmitted; (7) character of the load (jerky or constant); and (8) conditions such as contact with moisture, oil, or other deteriorating influences.

Over these factors the belt-man usually has little or no control. His problem is to take the conditions as he finds them, and apply a belt that will give the best service possible under the circumstances. Yet he may sometimes perform a real service by calling attention to a faulty arrangement, when the conditions are such that the fault may be corrected. Real economies may sometimes be effected by lengthening the distance between pulley centres, increasing the width of the pulley face, or by changing the arrangement of a vertical belt so as to give a certain degree of slant.

The factors which are under the belt man's control are these: (1) The kind of belt to be used, such as rubber, leather, canvas, etc.; (2) the grade, whether cheap, medium, or high; and (3) the weight of the belt, such as 4 or 6-ply, single or double.

In determining the kind of belting to be used, the merits of rubber belting should receive full consideration. It is economical in first cost, extremely efficient in service, and frequently outlasts other constructions. On the other hand, in places where constant contact with oil is unavoidable, a rubber belt will not give good service. The constant use of shifters is also injurious to a rubber belt.

In deciding upon the right grade for a particular service, the points to be especially considered are the size of the pulleys, the presence of idlers or other unusual conditions, and the speed. Small pulleys, operated at high speed, necessitate a high-quality belt. The reason for this is the internal wear between the various plies of fabric, and even between the fibres in each ply, as the belt rounds the pulleys. A high-grade rubber friction is the best possible protection against this internal wear, because it protects each fibre with an elastic coating which remains uninjured and which indeed retains its life and elasticity longer when in use than when lying idle.

In this connection, it should not be forgotten that the value of a particular rubber friction cannot be determined merely by the test showing 'pounds pull'. If the plies were fastened together with glue, this test would show a very high-grade belt, but we all know that such a belt could not give service. The most valuable property of rubber friction is that intangible quality called 'life'. There is no known test for this but length of service. In specifying the proper ply for the installation, the determining factors are the size of the pulleys, width of the belt, speed, and the horse-power to be delivered. The belt itself should be at least one inch less in width than the face of the pulley.

'GUNITE' FOR FIRE-WALLS

Some months ago the architects of a large factory in the East decided to use as a 'fire-wall' a hollow wall with 'gunite' sides two inches thick, with an eight-inch air space between, and with the side walls connected with gunite studs at from 5 to 7-ft. intervals. The outer walls were reinforced and the studs had two ⅜-in. round rods as vertical reinforcement. This construction was refused. 'Fire-wall' in insurance parlance is distinguishable from 'fire stop', in that the latter means a wall that will act as a temporary retardent to prevent the spread of fire, while a 'fire-wall' is supposed to be a wall that will actually prevent the spread of fire from one portion of a building to another portion. Inasmuch as the only material which had ever been classified as a 'fire-wall' construction, and the only construction that had been used in this connection, had been a brick wall not less than 12 in. thick and increasing in thickness due to the height and character of the partition, the architect was faced with the quandary of getting a decision in favor of the gunite construction or of delaying the erection of the plant for an indefinite period, on account of the scarcity of both brick and brick-masons. The insurance company was sufficiently interested to request that the Underwriters' laboratories make arrangements to test samples to be made in conformity with the scheme proposed. The final test was completed on June 3 and 4.

The samples tested were reproductions of a section of wall, the studs being spaced with 7-ft. centres and side walls extending about 18 in. beyond each stud to their intersection with the brick frame. The walls were 'shot' about April 20, and had cured since that time. To avoid excessive dampness, they had been surrounded with tarpaulins for the last

ten days, and two salamanders were kept burning under this cover. The laboratory and the underwriters' regulations for testing a 'fire-wall' provide that the sample shall be subjected for four hours to a heat ranging from 1000° within five minutes after the test is started to 1600° at one hour, and up to 2000° at four hours. The curve of the readings made in this test followed this theoretical curve closely. In addition it also provided that the face of the wall away from the flames shall not become hotter than 300°. When the first sample had been under heat for about 18 minutes a considerable spalling of the face occurred between one of the studs and the abutment about 18 in. away, but this had been expected as previous experiments had shown that gunite slabs demanded considerable opportunity for expansion between fixed points. In fact a hole about 15 in. diameter was opened up through the side toward the fire, but even with this handicap the sample was subjected for four hours and fifteen minutes to the heat above indicated without any sign of breaking. The heat was withdrawn at this period because of the fact that one of the outside thermometers showed a little more than 300°, although all the other four thermometers read considerably less. Strange to say the thermometer that showed the high reading was farthest away from the hole that had broken through the inner wall. The second test made on June 4 called for a similar sample to be subjected to heats up to 1600° for one hour, at which time the frame was removed from the furnace and the sample swung over so that it could be subjected to a stream of water through a 1¼-in. nozzle at 50 lb. pressure for five minutes. This sample at about the same period as the first sample showed similar spalling and a hole at almost exactly the same spot. The general impression was that the greatest initial heats were at the end of the furnace, and that when the stress on the short span was once relieved no further trouble occurred. When the water was thrown against the wall considerable cracking occurred, and after cooling it was seen that the slab had split for some distance back from the slabbing-point due to a lamination along the plane of the wire mesh. None of the material fell, however, nor was there the slightest spalling of the gunite. This led to the recommendation that the mesh be placed as near the centre of the slab as practicable in a wall of this kind, in order to allow for a considerable thickness of undisturbed material behind the wire if such lamination should occur.

It is uncertain pending the issuance of the official report exactly what the ruling will be, but inasmuch as all of the gentlemen present seemed to be satisfied, and in view of the statement made by one of them that he considered this wall "better than a 12-in. wall", it seems certain that gunite walls will be accepted as self-supporting 'fire walls' under certain conditions in steel or reinforced-concrete strutures. No tests have ever been made to show the value of concrete walls under similar conditions, but tests that have been made on concrete have indicated that gravel concrete will stand only a small amount of heat; that granite concrete breaks down under the water-test; that trap-rock and gravel concrete fuses and flows at 1800° to 2000°; but that a high-grade limestone concrete will withstand these heats. Offsetting this, however, is the fact that most of the limestones obtainable are not suitable. Also it is noted that, if limestone or slag screenings were used as the aggregate in gunite, even better results still would probably have been obtained, as the sand used in these tests was highly silicious. Gunite is much used for fire protection in the larger mines throughout the United States where timbers in shafts, stations, and other more or less permanent working passages are coated with a layer ½ to ¾ inches thick.

Bulletin L. 531 B, issued by the **Worthington Pump & Machinry Corporation,** describes Laidlaw 'feather-valve' air-compressors.

COMMERCIAL PARAGRAPHS

The C. L. Best Gas Traction Co. announces the establishment of its sales and display room at 730 Van Ness Avenue, San Francisco. The product of the company will be on display and full information regarding Best 'tracklayer' tractors may be obtained.

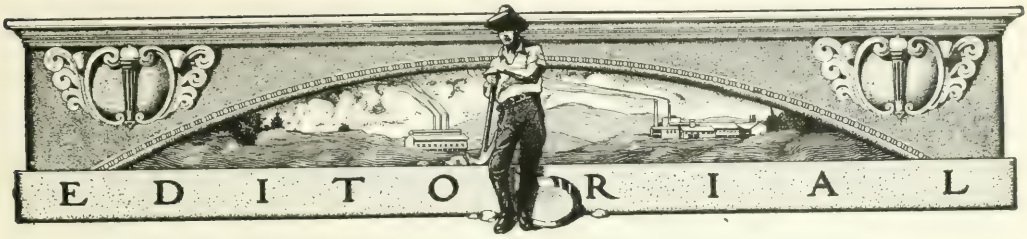
B. V. E. Nordberg, son of the pioneer engine and hoist-builder, B. V. Nordberg, has been appointed sales manager for the **Nordberg Manufacturing Co.,** Milwaukee. H. W. Dow, former sales manager, recently resigned to become vice-president and engineer for the **Forest Products Chemical Co.** at Memphis.

At the annual meeting of the stockholders of the **Westinghouse Electric & Manufacturing Co.** held at East Pittsburgh on June 9, the following directors were unamiously re-elected for three years: Guy E. Tripp, chairman, Joseph Marsh, president of the Standard Underground Cable Co., H. H. Westinghouse, chairman of the board, Westinghouse Air Brake Co., Albert H. Wiggin, chairman of the board of the Chase National Bank, and George W. Davison, president of the Central Union Trust Co., was selected to succeed James N. Wallace, deceased, for the term expiring in June 1921.

Recent advertisements of the Westinghouse Union Battery Co., Swissvale, Pennsylvania, have, unfortunately, led many to assume that the **Westinghouse Electric & Manufacturing Co.** was entering the storage-battery field. In order to clear away any misunderstanding, the Westinghouse Electric & Manufacturing Co. authorizes the statement that the Westinghouse Union Battery Co. is owned and controlled by the Westinghouse Air Brake Co., Wilmerding, Pennsylvania, and the Westinghouse Electric & Manufacturing Co. is not in any way connected with the manufacture, sale, distribution, or service of the product of the Westinghouse Union Battery Co.

The Chicago Pneumatic Tool Co., New York, announces the election of Allan E. Goodhue as vice-president in charge of sales. Mr. Goodhue since May 1, 1919, has been managing director of the company's English subsidiary, the Consolidated Pneumatic Tool Co., London; also director of European sales for the Chicago Pneumatic Tool Co. Mr. Goodhue was formerly for a number of years connected with the sales department of the Midvale Steel Co. and Midvale Steel & Ordnance Co. in Philadelphia, Chicago, and Boston, leaving that company in March 1918 to enter the service of the Government. From that time until January 1, 1919, when he became connected with the Chicago Pneumatic Tool Co., he was assistant manager of the steel and raw material section, production division, of the Emergency Fleet Corporation.

The General Fireproofing Co. in the May issue of its publication points out that the most important part of any industrial operation is the human part—the men who run it. Machines are important. Buildings are important. But they are useless without the men; whereas men could, in a pinch, make progress without either the machines or factories, as was the case before the invention of machinery. The house is one of the most important factors in shaping the true growth of the individual. Ramshackle dwellings cannot fail to impress their character upon their inmates, and ramshackle workers cannot fail to impress their character upon their work. The company believes that the question of proper 'industrial housing' is one of the most important considerations of the employer today and recommends permanent fire-resisting construction. Cement stucco on metal lath over reinforced concrete frame, produces a construction which is not only rigid and permanent, but possesses the insulating qualities so essential in exterior wall-work by having dead-air space, thereby keeping the building warm in winter and cool in summer.



T. A. RICKARD, - - - - Editor

WE take pleasure in publishing a description of the structural geology of the Las Chispas mine, in Sonora, by Mr. Fernando Montijo Jr., the Mexican engineer in charge of the property. It is gratifying to see the native-born taking a proper part in the development of the mineral resources of the country; it is also pleasant to find a Mexican technician so well able to express himself in our language.

AT a time when the high cost of everything, including government, is impressed upon all of us, it is regrettable that fifty Congressmen, with their wives and families, should start on a junket to the islands of the Pacific at the expense of the taxpayers. The transport 'Great Northern' sailed on July 5 with this party aboard. It is to be "a long cruise" among the islands, including the Philippines. We would like to know who authorized this public extravagance and what excuse there is offered for it. One of our local Congressmen is in the party; he should be asked to make an explanation.

ON another page we publish an article on the electrolytic separation of copper from copper-cobalt-nickel matte as performed at Fredericktown, Missouri. The article is by Mr. R. G. Knickerbocker, who described the incidence of bolshevism on mining in Siberia in our issue of May 8. Mr. Knickerbocker is now smelter superintendent of the Messina Transvaal Development Company, for which Mr. A. B. Emery is resident manager, in the Transvaal. The results of experiments and investigations into the production of a suitable solution of nickel and cobalt are given frankly, and they should prove helpful to others in like difficulties. It is rarely that the record of such work is given for publication, yet it is exactly the kind of information that is most useful.

IT is about time that San Francisco had a real morning newspaper. The Democratic convention adjourned on Saturday night at 11:40, after the 22nd ballot, yet the 'Examiner' of Sunday morning had no news later than the 20th ballot, whereas the 'Chronicle' did tell its readers that the Convention had adjourned, but failed to give the figures of the last ballot. On the following Tuesday morning the 'Chronicle' on its front page announced a deadlock at the 41st ballot, although shortly after midnight Governor Cox had been nominated. Of course, the people of this community know that both our morning papers go to press in the evening and are on sale soon after nine o'clock; both are belated evening papers; but the delegates from other cities must have remarked the pitiful lack of enterprise exhibited by both of them in failing to make an effort to record the doings of the Convention with some degree of promptitude. Owing to its geographical position, San Francisco offers extraordinary opportunities to a wide-awake publisher, but unfortunately our miserable morning newspapers are as noteworthy for the lack of worthy enterprise as they are notorious for their meanness and untrustworthiness.

STATISTICIANS of the Department of Agriculture declare that the country-wide shortage of farm labor has been constantly increasing until now it is 28%. There is no reason to doubt that this figure is approximately correct and it is entirely logical to conclude that unless there come a change the farmers will not be able to produce sufficient foodstuffs to supply the hundred million people in our own country. Even if the farmers could by extraordinary effort supply the deficiency, they would not do it; nor should it be expected of them. With an under-supplied market the same amount of profit can be obtained from 75 bushels of potatoes or 75 hogs as can be realized from 100, and like the rest of us the farmer sees no reason why he should not take advantage of his position. That is one reason the prices of foods are not coming down with those of some other commodities. The only solution is a return of workers to the farms. This may be brought about by a further increase in the prices of farm products to a point that will influence more people to engage in farming for themselves, and attract laborers to seek work on the farms at higher wages than they are getting in the so-called industrial occupations, which now offer a number of agreeable advantages in addition to better pay. An alternative is a sudden depression in industrial activity that would force the workers to seek employment in agricultural occupations rather than be idle. Whether we are engineers or laborers, merchants or clerks, we are interested in the farmer and the farm as being the source of that first essential commodity, food. Food we must have; but we will have to pay for it at a rate such that after sundry retailers, wholesalers, brokers, and packers have taken a toll there is enough left to make it worth while for someone to produce it. There are many angles to the problem, but it is safe to say that hope for material gain, rather than

an altruistic sense of responsibility to a hundred million stomachs, will re-fill the places of the missing 28%.

ACCORDING to the report of the third annual meeting of the Anglo-American Corporation of South Africa, that enterprise is making satisfactory progress. We note that Mr. Walter McDermott has joined the directorate, largely in consequence of the absorption of the Rand Selection Corporation, a subsidiary of the Consolidated Mines Selection Company, a successful enterprise with which Mr. McDermott has been identified from the start, in 1897. The Anglo-American has acquired the controlling interest in the Consolidated Diamond Mines of South-West Africa, which owns the diamantiferous area in the former German territory. A report was presented to the meeting by our friend Mr. W. L. Honnold, an American mining engineer well known in our West, and, as we recall, a graduate of the Michigan College of Mines. Mr. Honnold used to be manager of the Brakpan mine on the Rand. He gave an interesting description of the gravel from which the diamonds are washed, and quoted an estimate indicating that the diamond-field should yield 15 million carats. We note that the four principal diamond-producing companies in South Africa have agreed to restrict the production, each company being allowed a prescribed quota. The amount of annual sales is fixed at £12,000,000, of which De Beers is to contribute 51%, South-West Africa 21%, the Premier 18%, and Jagersfontein 10%. The minor producers are left to their own devices, which must be a comfort to them. The Anglo-American Corporation also holds blocks of shares in mining companies on the Rand. Mr. E. Oppenheimer, the chairman of the meeting, and of the corporation, stated that the premium on gold has been entirely absorbed by the increased expense, due to higher wages, the advance in the cost of supplies, the rise in banking exchange on London from Johannesburg, and the lessened efficiency of labor. The corporation is capitalized for £4,000,000 and has paid a dividend of 5% on account of the first half of the current year.

PERHAPS the most ludicrous thing at the Democratic powwow was the speech of Mr. Charles F. X. O'Brien, who placed before the convention the name of Governor Edwards, banker, vestryman, teetotaler, but avowed champion of the 'wet' cause. The speech was all the funnier because Mr. O'Brien had an impressively pompous demeanor; he took himself with exceeding seriousness—possibly to make up for the lack of it in the attitude of the delegates toward himself and his candidate. If, 40 years ago, before even Kansas had given prohibition a serious thought, some foe of booze had hired a yeggman to break into the vault wherein the Constitution reposes, and had in the middle of the night inscribed the 18th amendment on that revered document; and if the Supreme Court, upon discovering next morning the presence of this revolutionary addendum, had decreed, sapiently, that what has been writ could not be unwrit, but must become the law of the land; if these remarkable events had transpired, the speech of Mr. O'Brien might then have been comprehensible. His contention was that the people should have had a voice in a question of such serious moment; but that since by some mystic chicanery this amendment had been foisted on us, a candidate should be named for President who would make it his purpose to enable "the citizenry of the great and glorious, etc.", to raise its voice in protest. We can appreciate the argument of those who believe that the amendment infringes upon their personal liberty; we can sympathize with those who were wont to worship at the shrine of John Barleycorn; but we have no patience with the man who is so stupid as to insist that prohibition was put over on the people by some exterior force without their knowing it. What about the 45 States that have collectively and individually ratified the amendment? If the liquor people or anyone else want to continue the argument why not advance this line of reasoning: "By an overwhelming majority we let ourselves in for something. Having found out how it works some of us are sorry. Perhaps there are enough sorry ones to carry a vote for reconsideration."

COMPLYING with the order of Federal Judge Bourquin in the suit of Minerals Separation against the Butte & Superior company for alleged infringement of froth-flotation patents, the defendant has filed a complete record of operations since 1911 when its ore was shipped to the old mill at Basin, Montana, for the purpose of developing a satisfactory scheme of treatment. A complete record of ore mined and milled, concentrates produced and marketed, costs, and earnings is included in these data and the terms of the contracts under which the product was sold to sundry smelting companies are given. Some months ago the Butte & Superior filed an accounting in which it calculated that approximately $400,000 represented the difference between the actual proceeds from the company's operations and what could have been obtained if the patents of Minerals Separation as defined by the decision of the Supreme Court had not been infringed. This was not satisfactory to the owners of the patents. They obtained the order for the additional data, which have now been furnished, and from them the experts doubtless will proceed to calculate supposed damages running into millions of dollars. Last week Mr. Huston Thompson, of the Federal Trade Commission, opened hearings in San Francisco against Minerals Separation, on the charge of using unfair and coercive methods in attempting to prevent legitimate use of the flotation process.

THE prospect in Mexico is less gloomy than for many months; in fact at the moment the outlook may conservatively be described as cheerful. It is true that Pancho Villa has been entertaining himself at the expense of Generals Jesus Guajardo, Ignacio Enriquez, and Joaquin Amaro, but General Eugenio Martinez and Col. Sandoval are about to take command and these sterling soldiers are expected to comb the mountains of Chihuahua until Pancho is apprehended. We wish them well. General Jacinto Trevino, Secretary of Commerce and

Industry in the cabinet of Provisional President Adolfo De la Huerta, has not as yet agreed to nullify the objectionable restrictions regulating drilling for oil that were instituted by the Carranza regime, but he has shown a willingness to consider the contentions of the oil companies. This attitude has increased confidence among the American and other interests, and record production is being made. More than 11 million barrels was shipped during May and the Standard of New Jersey recently brought in a new well with a daily capacity of 100,000 barrels. It is reported that trains are running without military escort, an unusual thing in the country south of the Rio Grande; the Government has ordered the return of property confiscated years ago; and General Elias P. Calles, Secretary for War, has diverted the energy of many of the soldiers from plundering to road-building and other profitable work. Other indications of a return to normal are labor strikes at Puerto, in the State of Vera Cruz, and at Leguna, in Coahuila. General Calles, upon being appealed to, ordered the release of union leaders, who had been arrested, declaring as he did so that "the right to strike is sacred". Reports from Sonora are to the effect that the outlook has stimulated mining activity. A number of mills have resumed operation lately and several old mines are again producing, while at others unwatering has been started. At Nacozari the Phelps Dodge Corporation is planning to double the capacity of the Moctezuma concentrator, the project including the installation of seven new Diesel oil-engines. According to 'El Democrata', all of the political factions have agreed to support the candidacy of General Alvaro Obregon and he will presumably be chosen President at the general election, which has been set for September 5. Whether or not these favorable reports reflect the true state of affairs, and if so, whether this is simply a lull before another storm, is hard to say. It is difficult to believe that any radical change has taken place, and that the fundamental causes for turmoil have been removed, but if there is ever to be lawful order and peaceful industry a start must be made some time. Let us hope that the time has come.

Bad Language

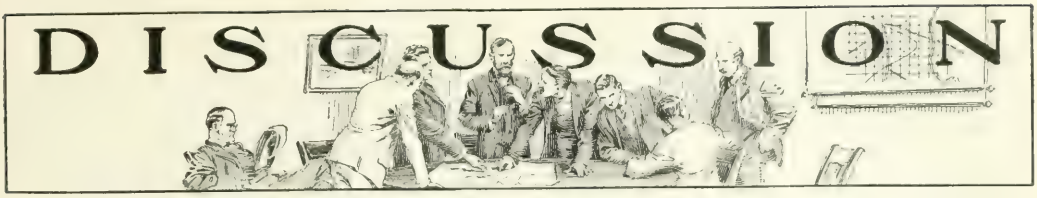
A few days ago we picked up a paper on the mining industry of Joplin presented before the recent meeting of the Zinc Institute at Chicago. We were impelled to read it because it bore the name of a man whom we knew to be a competent mining engineer. After reading a couple of paragraphs we laid it down in despair, because we found ourselves unable to follow the author in his statements concerning the condition of mining in that Missourian district. The reason for our bewilderment was the use of terms to which a local meaning was attached. It is more than probable that other readers, even those familiar with the literature of mining in places in which the language of America and of several other countries is spoken, would have been non-plussed as we were. The author of the paper in question, in accord with local usage, wrote of "ores" when he meant 'concentrates', namely, lead concentrate and zinc concentrate. When he spoke of "blende ore" and "calamine ore", he meant the mill-products containing a high proportion of the sulphide and the silicate of zinc, respectively. It is not his fault, nor ours, that in Europe the name 'calamine' stands for the carbonate of zinc, and that there the silicate is called 'smithsonite'. This is mentioned by the way, just to suggest the need for the adoption of a uniform nomenclature. Moreover, in Missouri, it appears, they talk of a "lead ore" and a "galena ore" interchangeably, although they differentiate between a "zinc ore" and a "calamine ore". Again, the "ore" may be the crude, but selected, product from the mine or it may be the concentrated product from the mill. To tell the truth, we had intended to publish the Joplin article in this paper, because it was a good review of the progress of the industry in that district, but we were not sufficiently confident of the meaning of the terms used to be able to translate them into correct technical English, although we have been to Joplin and know something of the local lingo. Therefore we did not feel warranted in editing the paper for the benefit of our readers, who otherwise would have been unable to understand it. We ask, what chance had an intelligent reader at London, Melbourne, Shanghai, Vancouver, or Lima of understanding this paper as read before the Zinc Institute at Chicago? A plague on these localisms! They are not even discriminating in their own way, largely because they reproduce the usage of the stope and mill. As we have said often, it is well for us to go to the miner and the mill-man for knowledge concerning the mining and milling of ore, because that is *their* special business, but why in the names of Roget and March should technical writers, who are supposed to be specialists in *their* business, which, among other things, is to write intelligibly, go to the artisan and the mechanic for the terms they use in their writing or speaking? Joplin is not peculiar in its adoption of a half-baked terminology. At Central City, Colorado, it is the established custom to speak of the pyritic concentrate, containing gold and silver, and sometimes copper, as "tailings". There used to be a regular trade in "tailings", this mill-product being bought in small lots by brokers for the purpose of preparing a mixture upon which advantageous terms could be obtained from the smelters at Denver. Everybody spoke of "tailings", when they meant not the discard or refuse from the stamp-milling and bumping-table operations, but the valuable sulphidic concentrate. Such usage beggars language. To say it is unscientific is not enough; it is puerile. In Boulder county, Colorado, the miners speak of "hornblende", when they mean the dark agatized quartz, 'hornstone'. Shall we copy that blunder and introduce it into the literature of mining, just because some excellent single-hand miners happen not to know what they are talking about? In the Michigan copper country they call their ore "rock" and their crushing-plant at the shaft a "rock-house". They do not use the term 'ore'. Only last week a distinguished engineer, formerly connected with the Calumet & Hecla, told us that it was his understanding that the word 'ore'

could not be applied properly to an economic mine-product containing metal in the native state, and that "copper rock" was as correct, for example, as "gold quartz". The answer is that both are technically incorrect, the verbal coinage of unscientific people unable to speak or write with discrimination. The "gold quartz" of California is a misfit, because the ore of the Mother Lode, for example, contains only a minor proportion of quartz, the preponderant constituent being slate. Gold is associated with quartz in most veins, all over the world, but not in all; the product of the mine usually contains some quartz and a minute proportion of gold, so that "gold quartz" is not accurately descriptive; moreover it ignores the economic factor, that is, whether the proportion of gold is sufficient to make the rock an 'ore'. This last is a term with which we cannot afford to play fast and loose; it is defined as rock contaning a valuable mineral in such proportion as to constitute an economic product, that is, one that can be exploited, at a given time and place, profitably. The idea of profit is implicit, for mining is performed for the purpose of making money. 'Mineral', of course, includes native metal; native copper is as much a mineral as chalcocite, native silver as argentite, native gold as calaverite. "Copper rock", on the face of it, means a rock containing copper or made up largely of copper; but the idea of profitable exploitation is not there. "Copper ore" carries the essential significance of economic value. The test is to take such local vulgarisms as those we have quoted from Joplin, Central City, Houghton, and Sutter Creek, and ask persons well informed in mining affairs in other districts what they mean. The misleading character of these spurious terms will then become manifest, for their descriptive value will be found to be far below par; they pass current locally, like the token coinage of a depreciated currency.

To some people exactitude in these matters is meticulous. They do not realize how spurious words get into use in consequence of a careless attitude on the part of those who ought to know better. It is common to speak of "slack lime" or "slacked lime", when, of course, the right word is 'slake' or 'slaked'. "Slack" means nothing in regard to lime; 'slake' is beautifully descriptive of the manner in which lime absorbs water with a sizzle, like a thirsty man on a hot day. The same people talk of a "larry", which is not a word in our language; they mean 'lorry'. They use such abstract terms as "capping" and "filling" in lieu of the concrete and precise 'cap' and 'fill'. They use "muck" and "dirt", which signify nothing. "Feldspar" came into use simply because Kirwan in his book on mineralogy failed to detect a typographical error, whereby a 'd' was inserted in 'felspar'. A majority, it is sad to say, of technical men use 'data' as if it were a singular and as if it were a synonym for 'information'. Many miners speak of "stratas". Are we to be the unprotesting victims of such illiteracies? Is it not worth while to preserve our language from such corruptions for the sake not only of our literary inheritance from the great ones of the past, from Chaucer and Shakespeare, from Addison and Ruskin, but also for the sake of that precision of expression upon which all scientific writing depends if it is to serve as a means of exact statement?

The Work of Congress

Tradition was perpetuated by Congress in the session that began on December 1 and ended just in time for the Republican senators to participate in the 'deliberations' at Chicago last month. Much was said and little was accomplished in the way of passing bills. The Railroad Transportation Act, establishing the Railroad Labor Board, before which hearings are now being held in Chicago on the proposed increase in wages, and the Water Power Act, which should stimulate the development of hydro-electric projects for industrial power, were among the few important pieces of legislation actually accomplished. A number of bills of particular interest to the mining fraternity were introduced. The War Minerals Relief Bill, designed to permit appeal from the decision of the Interior Department to the Court of Claims or the Supreme Court, was passed by the Senate and reported by the Mines committee of the House, at which point progress was arrested. Representative McFadden's bill providing a premium on newly mined gold and at the same time placing an excise tax on gold used in the arts and industries, was the subject of a series of hearings before the House Committee on Ways and Means. It will repose there until next December. The Senate Committee on Finance reported bills previously passed by the House that provide a tariff of magnesite, tungsten, and zinc. Efforts to reach a vote on these measures were unavailing because of the pressure of multitudinous other affairs. Bills providing for duties on antimony, baryte, chromium, graphite, manganese, mercury, molybdenum, pyrite, and potash are pending before the Ways and Means committee of the House, and similar bills are in preparation dealing with mica, tin, and lead. A bill recently introduced provides for the creation of a division of mines and geology in the Department of the Interior with an Assistant Secretary of the Interior as the executive head. He shall be technically qualified by experience and education to direct the affairs of the division, which shall undertake the present activities of the Bureau of Mines and the Geological Survey, together with such other work related to mining, metallurgy, and geology as shall be designated by the President. The purpose is to do away with the duplication of effort, and to coordinate activities of the several offices. The creation of the proposed Department of Public Works, which would result in the partial reorganization of the various major departments of the executive branch of the Government to consolidate in a systematic way all engineering work, except the purely military, appears to be a more important project and deserving of attention first. The scheme to combine the Bureau of Mines and the Geological Survey might be found advisable later, but an overlapping of the work of these two offices is not of sufficient moment urgently to require attention.



A Call to Arms

The Editor:

Sir—If you would help to save our country from taking a perpendicular course straight down to hell, pull off your coat and jump to it right now. There are several million people in the United States ready to help in this job, and several thousand in foreign countries who will gladly come home and help to muck out the dirty filth of politics which is scattered in heaps all over the country.

This is the idea. In your paper from cover to cover, and in the heaviest black type, advocate the organization of a Non-Partisan Party and place at the head of it Herbert Hoover. Let your motto be: "Our government must be run by the people, and not by a few professional politicians." Ring out the motto in clarion tones across and up and down the land, and let it be known that such a party stands for honest government and will not be dominated by the stench of dirty politics as has been done in the past by both the great parties. Make it an open season on every kind of a politician, regardless of creed, color or age, in any place or spot from Town Constable up to Governor, from representatives in State legislatures, to members of Congress and the Senate.

It certainly is high time something was done when two handfuls of grafting party politicians can force down our throats any candidate for President they may desire, and then make us like it, just as has been done at Chicago and will be done again at San Francisco.

The only remedy is for the people to refuse to jump at the crack of the political whips and follow a selected leader like a flock of sheep. They must organize a Non-Partisan Party, for elective offices, use lawyers very sparingly, but lots of business men, accountants, engineers, mechanics, doctors, and hard-headed farmers with or without whiskers. Then there would be a show to run our government on a business basis and put a stop to political graft, which, at the present time, is without end and growing worse all the time.

There must be a change in our political system very soon and thinking people are demanding it. If this is not forthcoming, for the sake of decency, let us throw a heavy mantle over the statute of Liberty so she cannot see us as we go gaily sliding down the chutes to hell.

There, Mr. Editor, I feel a little bit better after getting this load off my chest, but still feel a trifle sad. However, I know a friend who has some raw and fiery tequila with a kick to it like a mule, so I know I shall be singing like a mocking bird pretty soon, and by morning I will be completely recovered and joyously looking forward to another Mexican revolution.

A. E. Zeh.

Cananea, Mexico.

Some Observations on Smelting

The Editor:

Sir—For the questionable enlightenment of 'H. H. S.' I wish to contribute some of my own thoughts on this topic. His letter in your issue of June 19 was a real treat.

First, smelting may be defined as a melting with chemical change producing liquids, separable by difference of specific gravity. Second, it is to be observed, even though high-grade material is added during converting, most of the matte is fed to the converter as a molten mass. In order to convert economically, a 40% to 50% matte is required. Smelting, instead of simple melting, must precede the converting; the progress of the ore being from the roaster to the reverberatory, then to the converter. The modern reverberatory is, as H. H. S. suggests, a "melter" since the furnace atmosphere is neutral, or reducing, instead of oxidizing, as I was taught by my good professor in days gone by.

The self-firing of reverberatories by blowing dry flotation concentrate through the tuyeres as a substitute for pulverized-coal firing sounds reasonable, as most roasters are self-firing. Others have anticipated the process. J. H. Klepinger and Peter Thill (or J. H. Klepinger and Archie Wheeler) all formerly with the old Boston and Montana Reduction Works, at Great Falls, Montana, have letters of patent covering the principle of calcine (or concentrate) and pulverized coal being blown separately into a reverberatory. To my knowledge no experiments were ever made with the process.

According to the present-day practice the heat of roasting finds a most important use, namely, in the drying of concentrate as it descends through the roaster. In this connection it should be observed that sometimes the heat of the burned sulphur must be supplemented by extraneous firing.

H. H. S. is normal. He seeks to accomplish an object with the least effort. In the problem under consideration, the aim is to produce copper direct from the ore. This has been the ambition of a host of men. E. D. Peters in his 'Practice of Copper Smelting' dwells on the attempts to produce copper direct from the blast-furnace, without converting. In recent time we have a twin converter affair that was predicted to have possibilities. As I understand it, one chamber smelts and the other converts.

For my part I see no way to eliminate the reverberatory, except to operate the converter semi-continuously instead of in batches like a concrete mixer. This is to utilize the surplus heat not necessary for liquidation to smelt the dried concentrate (or calcine) so added. The blister copper is to be drawn off from the bottom and the slag is to be poured off the top.

This process once started would complete the cycle of operation in the following order:

Drawing of copper.
Charging of materials.
Blowing for slag.
Pouring of slag—that is the surplus.
Blowing for copper.

On the other hand the usual process, self-primed or rather reverberatory-primed, would complete the cycle of operation in this order:

Charging of matte.
Blowing for slag.
Pouring of slag.
Blowing for copper.
Pouring of copper.

It matters not with which foot you start. Either will take you to the same destination. This process would resemble a blast-furnace and reverberatory practice in that the converter always contains molten material and differs from them in that the matte is not produced continuously. It differs from the ordinary converter practice in that the converter always contains molten material.

C. W. Tandy.

Garfield, Utah, June 25.

A Code of Ethics

The Editor:

Sir—The '14 points' of the Code of Ethics of the American Society of Mechanical Engineers appearing in your issue of June 19 and the editorial comment thereon in your issue of July 3 have interested me, as, I suppose, they have other members of the engineering profession. The Code of the Mechanical Engineers is identical with that prepared by the American Society of Civil Engineers, which was, I believe, the first among our engineering societies to go into competition with Moses. However, making codes, like the influenza, is infectious, so we may expect the epidemic to spread to a number, at least, of the other societies before it runs its course.

The objections raised in your editorial to specific provisions of the Code are well founded, but the more important question, in my opinion, is, why have a special code of professional ethics, or, in fact, any special code of ethics?

In the first place, what good does it do? The spirit behind these codes is doubtless excellent, but the ordinary upright member of the profession has always observed the spirit and will continue to do so, forgetting about the letter. The shyster in the engineering professions, where there is as yet no compulsion behind the adopted codes, will continue to disregard both spirit and letter whenever it appears to further his interests. In some of the other professions, where there are various forms of compulsion behind the written or unwritten codes, the shyster keeps the letter and violates the spirit.

On the other hand all such codes are definitely harmful because they tend to perpetuate the outworn theory that certain classes of men are holier than the rest of humanity and that upon them special standards of conduct are obligatory. That this theory has a bad effect upon both the elect and the unregenerate does not require proof.

If an engineer violates the ordinary rules of public or private decency, throw him out of the Society, and, if it seems advisable, let the world know the reason why. It is not done now, to be sure, but no fancy Code of Ethics is going to make it any easier. If, on the other hand, he comports himself as any honest citizen should, leave him alone, or, if you must say something, tell him that the Society is proud of him.

The sooner engineers and other professional men forget about special codes of ethics and get back to the Golden Rule and the ideal of Service, the better it will be for them and for the world in general.

A. T. Parsons.

San Francisco, June 30.

The Case Oil-Fired Assay-Furnace

The Editor:

Sir—I wish to comment on the criticism of my article on this subject.

Mr. Sherlock states that the turning of the front baffle so that the flame hits the broad side of it enables him to cupel with the door open. In previously trying this arrangement, I found that it took almost twice as long to complete the fusions as it did by the method described in my article. This was due to the smaller amount of fuel that could be fed into the furnace and secure perfect combustion. It is also evident that 33 cupellations would occupy only about 50% of the muffle-space even in the smaller sizes of Case furnaces. That comparatively small number of buttons may be satisfactorily cupelled with the muffle-door open, for they can be placed in the most advantageous parts of the muffle. However, not all assayers can afford to use only part of their equipment and very often the last row of cupels is only two or three inches from the front end of the muffle. Under this condition, cupelling with a door open is neither practicable nor possible regardless of any baffle arrangement.

Mr. Sherlock further states that the gas or fume entering the interior of the muffle through the cracks does not interfere. Oxygen is needed for cupellation and if the muffle is being continually filled with an inactive or reducing gas it is plain that the oxidizing atmosphere is partly or even entirely prevented from coming in contact with the molten buttons and so the cupellation is retarded, or ceases altogether.

The opening or lifting of the upper part of the boss—opening of slots in some types—increases the amount of air available for combustion. This increase varies, but it is about 10% of the amount of air passing through the burner. This extra amount of air is forced into the fur-

nace by the difference in weight of the air-columns outside and inside and by the vacuum created by the spray of oil and air entering into the furnace through a rather narrow opening. Any operator can satisfy himself in regard to the above statement by lifting the upper half of the boss and regulating the air, oil, and dampers so that only a small flame is visible above the top of the furnace, then replacing the upper half of the boss and noting the flame and smoke that presently appears just above the dampers.

I agree with P. L. Guppy on the desirability of a low-pressure air-flame for assay-work. There were no statements in my article which could have been construed as a criticism of the low-pressure air used in the Case furnace. That the mechanical arrangement of the various parts was not all that could be desired is best proved by the extensive modification of the new Case oil-fired assay-furnace.

F. Borzynski.

Como, June 20.

Books Written in a Hurry

The Editor:

Sir—Looking over the latest publications for sale in a book-store in this city recently, I came across 'Herbert Hoover: The Man and His Work', by Vernon Kellogg, published in 1920 by D. Appleton & Co. of New York. As I have watched Mr. Hoover's progress since he was at Kalgoorlie, Western Australia, in 1900 or so, and really believe him to be the man most fitted for the Presidency of the United States, I became interested in this book, which, I believe is a reprint of a series of articles appearing in an Eastern magazine. I opened it at page 105, and read the following:

"His work took him back to Australia, the land of his first notable success, but this time into South Australia, instead of West Australia. Here he took personal charge of a large constructive undertaking in connection with the rehabilitation of the famous Broken Hill mines. These mines were in the inhospitable wastes of the Great Stony Desert, four or five hundred miles north of Adelaide, the port city. The living and working conditions on the desert were a little worse than awful, but by his technical and organizing ability he brought to life the two or three abandoned mines that constituted the Broken Hill properties, and adding to them some adjoining lower grade mines, converted the whole group from a state of great unrealized possibilities into one of highly profitable actualities.

"An important factor in this achievement was his origination and successful development of a process for extracting the zinc from ores that had already been treated for the other metals, and then cast aside as worthless residues. There were 14,000,000 tons of these residues on the Broken Hill dumps, and from them he derived large returns for the company that he had organized to purchase the property. He also introduced new metallurgical processes for the profitable handling of the low-grade sulphide ores that constituted most of the mineral body of the mines. Indeed, this work in South Australia did much to help prove to him what has long been one of his cardinal beliefs, namely, that the safe backbone of mining lies in the handling of large bodies of low-grade ores. When such great orebodies are given the benefit of proper metallurgical processes, and large organizing and intelligent building up of extensive plants, mining leaves the realms of speculation and becomes a certain and stable business.

"All this successful work in South Australia occupied but seven months . . . "

'Ye Gods'! I ejaculated, and said to a person near-by that Hoover needed protection from his friends; also that the matter was a libel on Australians. I am certain that Hoover never read proof on this section of Kellogg's book, as he would not have permitted it to pass. The only way to criticize the matter is to analyze each sentence:

(1) Broken Hill is not in South Australia, but in New South Wales, although only a short distance over the border. Practically the only mining in South Australia is at Wallaroo and Moonta, and at Iron Knob, with the great lead smelter at Port Pirie; but Hoover had nothing to do with them. Adelaide is not the port city, it being 12 miles from its own port. Port Pirie is the outlet for the Broken Hill field.

(2) Although the Barrier (Broken Hill) is in an arid region, it is by no means an inhospitable waste; while the living and working conditions in a city of over 20,000 people were not "a little worse than awful". I have been there.

(3) Instead of there being a group of large mines contributing 10% of the world's lead, 5% of its silver, and 20% of its zinc (in concentrates), Mr. Kellogg would have us believe that there were only two or three abandoned mines on the Barrier, with goats browsing on the dumps. His admission of 14 million tons of residues does not point to two or three mines. Why, at that time I know that the South and Central mines were estimated to contain over 4,000,000 tons of ore; and ore that carries 15% lead, 8 oz. silver, and 10% zinc is by no means low-grade. The Broken Hill Proprietary had by that time paid about £8,000,000 in dividends.

I am not sure of the year in which Mr. Hoover was at Broken Hill, but it must have been about 1906, when the Zinc Corporation, which is the company referred to in this book, was trying new processes almost daily and spoiled the reputations of a number of reputable men for a time. The corporation was in sore straits, and became the current topic in Australian and London papers. Eventually, after getting more money in London, local advice and that of Theodore Hoover—Herbert's brother—and absorbing the South Blocks mine, the Corporation passed through its troubles, and is now one of the big operators at Broken Hill. This rehabilitation occupied a long period. I have never heard of Herbert Hoover being responsible for the development of any of the flotation processes in use there. The metallurgists whose names are best known in this connection are Potter,

Delprat, Bradford, Shellshear, Courtney, De Bavay, Hebbard, Horwood, and Lyster.

Anybody reading that "the safe backbone of mining lies in the handling of large bodies of low-grade ores", would think that this was something new, whereas in America and other countries such a theory has been in practice at many mines for many years, and Mr. Hoover expounded it in his 'Principles of Mining'. As you, Mr. Editor, have discussed mining as a speculation and as a stable business, I don't care to intrude.

After reading the quoted page I did not go further, but some time I may look at the section on Kalgoorlie, where I spent nearly 12 years, up to 1912; yet I am afraid I may be tempted to peruse that critically also. It is a pity that in his admiration for Mr. Hoover, Mr. Kellogg was not more careful, and that the former did not edit the matter before going to press. I am now curious to know what my friends in Australia will say; but I can guess.

M. W. von Bernewitz.

San Francisco, June 17.

Recent Metallurgy at Trail, B. C.

The Editor:

Sir—Referring to the excellent article on this subject in your issue of June 12, by F. H. Mason, in which he makes note of the Dings magnetic separators: Mr. Mason has not made it clear as to the type of machine and operation. In fact it is a two-belt machine and not a one-belt machine as he states. It is also of the high-intensity type. This machine has to operate with an extremely large gap, because the magnets and belts cannot be submerged, consequently they have to use a high-intensity magnet to obtain sufficient pulling force to reach the material lying upon the belt and covered with water. Underneath the poles of this machine there is an intense boiling action, and the pyrrhotite, which is attracted to the poles, is washed by this boiling action, freeing itself from the blende.

In your issue of March 13 you have another excellent article on 'Magnetic Separation on Bismuth, Tin, and Tungsten in Tasmania'. The authors state, on page 380, in regard to the standard Wetherill separator, that "these machines are not suitable for slime, that is, a material passing through a 150-mesh sieve." Also, "For slimy ores a magnetic separator that will treat the wet material is required." This is practically my experience and opinion. Mr. Mason, however, has not pointed out that this new type B-W wet magnetic separator is separating a pulp ground to pass through a 100-mesh screen. All through 100-mesh screen necessarily means at least 75% through 200-mesh. Consequently they are making a separation which has before been considered impossible. At the same time wet separating eliminates dust and dirt and the usual trouble in a dry plant, and removes the objections stated above.

I have not exact information here regarding the present arrangement at Trail, but when there last, the roasted and ground ore was fed first to six machines, making a lead-zinc concentrate, going directly to the Deister tables. There was a second battery of six machines, re-treating the re-ground magnetic portion. This was followed by a third set of five machines and a final step of one unit, making eighteen machines in all, for 600 tons capacity.

P. R. Hines.

Milwaukee, June 24.

Safety in Underground Haulage

Some standard regulations governing the operations of underground haulage are included in a recent bulletin of the Colorado Bureau of Mines. Cars operated by hand should have a convenient handle so that it is unnecessary for the trammer to place his fingers inside or outside the car-body. Depending upon the system used, the capacity of a car should not be too great, nor should too many cars be hauled in one train. The body and running-gears of cars should be kept in good condition. Where necessary cars should be provided with adequate brakes so that the hazard offered by the grade of the tracks will be reasonably overcome. Grades should not be so steep that they offer danger from derailment of cars. Locomotives should be of an approved type with all necessary appliances for their safe operation. They should be provided with head-lights and gongs. Gasoline-locomotives should be used only by special written permission of the Commissioner of Mines. Locomotives should be kept in good condition. The following minimum clearance should be provided: between top of cars and back, two feet; between sides of car and timber or rock sides of haulageway, six inches; between top of car and trolley, 18 inches. Where electric haulage is used, shaft-stations must be electrically lighted and haulage-ways should have electric-light bulbs at least every 200 ft. For animal-tramming a light must be carried on the first car of the trip or by the driver. For hand-tramming a light must be carried by the trammer or on front of car. Rails should be of such weight as to safely carry the maximum load that may be imposed at maximum speed. They should be firmly spiked, have suitable joint fastenings, and rest on a sufficient number of ties of adequate dimensions. Frogs and switches should be properly blocked on motor-haulage roads. The track should be properly aligned and free from high joints, broken rails, defective switches and frogs. Chute lips should not project more than three inches over the nearest side of the cars. Jumping moving cars and uncoupling cars moving at a speed exceeding four miles per hour should be prohibited. Cars without brakes should not be ridden on grades. Speed of trains should not be greater than the conditions of the track make safe—in no case over 15 miles per hour. Where mechanical haulage is used and there is not room to pass at all points, refuge or shelter places, affording space of at least two and one-half feet at each side between the widest portion of cars or train and walls, should be provided not more than 50 ft. apart. These places must be kept open and clear at all times.

Electrolytic Separation of Copper From a Copper-Cobalt-Nickel Matte

By R. G. KNICKERBOCKER

Introduction. This article describes the operation of the copper department of the plant of the Missouri Cobalt Co., at Fredericktown, Missouri, of which I had charge during the first half of 1919. It should be remembered that copper was a by-product, the principle object of the treatment being the production of a suitable solution of the nickel and cobalt from which the copper had been entirely removed. Accordingly there will be some departure from standard practice in the electrolytic precipitation of copper on account of this special application of the process. A statement of the peculiar conditions and the measures taken to improve the results should be valuable. In order to simplify the discussion it is divided into four parts, namely, (1) the quality of the products delivered to the copper department, (2) the leaching plant, (3) the electrolytic plant, and (4) the furnace-refinery. The accompanying general flow-sheet (Fig. 1) shows the relation of the copper department to the scheme of treatment.

Products Delivered to Copper Department. The analysis of the anodes from No. 2 blast-furnace averaged 55% copper, 19% nickel, 6% cobalt, 9% sulphur, and 10% iron. In the preliminary testing it had been determined that successful electrolysis required the sulphur-content to be below 3% and the iron between 7 and 8%. It was, however, found impracticable to produce a matte with this combination of low sulphur and high iron, because of the formation of sows in the blast-furnace. I have known this furnace to be blown in and out five times in one month. We had to handle these high-sulphur (7 to 8%) anodes very carefully, as they are extremely brittle and even with care they would break upon being immersed in the warm electrolyte. The high iron-content was necessary to prevent loss of cobalt in the slag.

The first anodes were cast with the Walker side-lug for support in the cells, but the brittleness of the metal caused these lugs to crack and most of the anodes were without lugs by the time they reached the cell-room. Then we tried the wire-loop type, in which heavy loops of copper-wire are held in place by a slot in the anode-mold. The vertical lug that held this wire made a re-entrant angle with the body of the casting and 50% of the anodes cracked as shown in Fig. 2. The electrolyte entered this opening and dissolved the copper wire, thereby allowing the anode to drop to the bottom of the cell, where it would cut a hole in the lead lining. Later this re-entrant angle was filled with metal, giving an angle of approximately 45° with the body of the casting. The anode was also made thicker (2¼ in. at the top to 1¾ in. at the bottom), and this type gave much better service.

The method of casting the anodes was crude, and a poor separation of matte from slag was made. No settler was used, the furnace being tapped into a 6-ft. launder that discharged direct into the anode-molds. A wooden rake served to fill the corners in the mold as well as to skim off the slag. More than a quarter of the anodes had to be cleaned by hand. Besides the slag that was left sticking on the outside, and which was easily removed, there was the slag mixed with the metal in the interior of the casting. This occluded slag caused surprising increases of voltage in the cell-room. Another bad feature of the slag was the warping of the anode caused by the difference in conductivity of the two sides. This gave an anode that would touch the cathodes when placed in the cell, causing short circuits. An oil-fired tilting barrel-type of ladle in conjunction with an anode-casting wheel, operated by hand, was tried, but did not prove a success.

The anode that gave the best results was light-gray and dense; it had a close structure and was without gas-holes. These anodes were also tough and corroded evenly in the cell in case they were free from slag. The North American Lead Co., which preceded the Missouri Cobalt Co., made an anode in a reverberatory furnace that was tough, white in color, and resembled soft steel in physical characteristics. This was due to the larger proportions of copper, cobalt, and nickel, with small amounts of iron and sulphur. This was the anode that the Missouri Cobalt test-work called for, but the blast-furnace department was unable to turn it out. Such an anode would have been easy to electrolyze.

The roasted and pulverized matte as delivered to the leaching plant, to be used for the making of the electrolyte solution, was not quite so variable in composition as the anodes, but in physical condition and quantity it varied even more. Twelve to 14 tons of this matte came daily from No. 1 blast-furnace. The residue from the leach, amounting to 9 or 10 tons, was sent to the No. 2 blast-furnace. The following are typical analyses:

	Copper	Sulphuric acid	Cobalt	Nickel	Iron	Sulphur	Chlorine
	%	%	%	%	%	%	%
Roasted matte	20.0	..	2.0	8.0	10.0	4.0	....
Leached residue	12.0	..	1.8	7.6	11.0	4.2	....
Electrolyte	3.5	3.0	0.2	0.4	0.8	0.1	0.015

The leach was not made with the idea of a high extraction, but only for the purpose of supplying the electrolyte. If the roast was not carried to 4% sulphur or under, the cobalt sulphate seemed to act as a coagulator of the raw sulphides and this residue would set in the tank and would have to be taken out with pick and shovel. Even when the chemical conditions were ideal the residue could not be allowed to stand after the solu-

tion was decanted or it would cause similar trouble. Provided the roast analyzed below 3% sulphur and 10% iron, and would pass 20-mesh, we had little trouble in making the required 45 tons of 3.5% copper electrolyte from 12 to 14 tons of matte every 24 hours.

The acid used in the leaching plant was of ordinary commercial quality, 60°B., and gave no trouble from chemical impurities. The water used was of poor quality; it contained calcium and magnesium salts, which precipitated in the tanks and pipe-lines of our circulation system. Much time was lost in cleaning the pipe-lines. At the time I took charge there were no means for heating solutions in the storage-vats, and the difference in temperature of the cell-solution caused additional precipitation in the pipe-lines. Accordingly steam-coils were placed on the bottom of each vat and the solutions were kept at the same temperature throughout the plant. Similar crystals formed on the sides of the lead lining in the cells and were taken out in the sludge. The analysis of crystals obtained from sludge, in water-soluble metals, is as follows:

	%
Copper	4.86
Cobalt	1.88
Nickel	3.73

At one time the lead in the matte was recovered by a chloride leach and considerable salt was left lying on the ground outside the leaching plant. Whenever it rained this salt was washed into our sumps and contaminated the electrolyte with an overcharge of chlorine. This had a bad effect on the cathodes and at one time entirely stopped the production of starting-sheets.

The Leaching Plant. A general plan of the plant is shown in Fig. 3. A cycle of operations was as follows: the tank first received the wash from the last previous charge. The solution contained 8% sulphuric acid and was between 80° and 90°C., having been heated by a steam agitator during the night. The matte was dumped into the vat while the steam agitator was operating under 90-lb. pressure. Three hours was required for introducing the matte, and the agitation was continued only a little longer. The electrolyte was then decanted or siphoned to the storage-vat. Wash-water was added to the residue, and agitated 30 minutes, the liquor then being siphoned into the next vat, preparatory to another cycle. The residue was dumped through the discharge-cock and laundered into a tub from which it was wheeled to No. 2 blast-furnace. Under normal conditions one vat per day was leached.

The vats were without lead lining, they had inferior pipe-fittings, and poor arrangements for dumping, and the work was hard on the men on account of the dripping. There was constant trouble.

The Electrolytic Plant. As shown in the plan, Fig. 4, there are four sub-divisions of the plant, namely: (1) starting-sheet division, (2) cathode division, (3) soft copper division, and (4) lead-cell division. The work of making starting-sheets was arranged as follows: two men spent 8 hours lifting the copper blanks from the cells and stripping off the sheets; they weighed and counted them, and carried them to the trimming and hanging-table; one man painted the necessary blanks and a boy hung the new sheets during the day-time.

The anodes used in the starting-sheet cells were 8 in. longer than those in the regular cells. This was on account of the length of the copper blanks used. In fact, we found that, on continued use of these blanks with the shorter anodes, the high-acid electrolyte would layer very readily in the space just beneath the short anodes and would tend to dissolve rapidly that portion of the copper blank upon which no deposition was taking place.

The circulating solution for the starting-sheet rows was raised by an Antisdell pump which gave excellent service. We frequently wished that the other four pumps for the regular rows were also of this type.

The quantity of acid in the electrolyte was determined by the foreman of the leaching plant, who, when I first went there, maintained the strength of the starting-sheet solution at 6% free acid. This was then thought necessary to produce good starting-sheets but it was subsequently shown that 3% acid would give a tougher product. When the change was made it was no longer necessary to return the solution, depleted in copper, to the leaching plant, and the result was the discontinuance of a troublesome pump and pipe-line. Under the old method of using 6% sulphuric acid, the electrolyte that went to the starting-sheet cells contained at least 2% iron in solution; the amount of ferric iron increased with the length of time that this electrolyte was used. The current efficiency among the starting-sheets in February 1918 under the old system was 84%. The time lost due to power-plant delays or shortages of anodes or of solution is not covered by this efficiency figure. The proportion of good sheets made under the old system averaged about 60%. This sheet was made in 24 hours and weighed about 4½ lb. Under the new system we used twice as many cells, but only stripped at 48-hour intervals, thereby making a sheet whose approximate weight was 8 to 10 pounds.

About March 15, the proportion of starting-sheet scrap increased rapidly, and owing to changes in the material coming to the electrolytic department a serious condition developed. By the first of April we were unable to make a single sheet. The average analysis of the solution that would not make starting-sheets follows: 6.5% acid, 3.0% copper, 2.0% iron, 0.025% chlorine. The composite analysis of the anodes in the cells at this time was 56.9% copper, 19.5% nickel, 5.5% cobalt, 2.5% lead, 9.3% iron, 7.0% sulphur.

The difficulty was that the starting-sheet would break upon being bent 180° in one direction. We tried every change possible, made solution from pure water instead of old wash-water, cleaned all the sumps, storage-vats, pipe-lines, and other places of possible contamination, but with no beneficial result. We then started a series of tests, the results of which are given below. The tests were conducted in a cell 20 by 15 by 15 in., with a solution temperature of 50°C. The current density was maintained at 10.

Test No. 1

To determine if the trouble was in the water used in the leaching plant.

	Voltage	Acid %	Copper %	Chlorine %	Iron %	Number of bends
Matte and distilled water	0.4–0.6	6.0	3.5	0.007	2.0	1
Matte and leach-plant solution	0.4–0.6	6.0	3.5	0.013	1.8	1

This seemed to prove that whatever the impurity in the electrolyte, it did not come from the water.

Test No. 2

	Voltage	Acid %	Copper %	Chlorine %	Iron %	Number of bends
Matte and leach-plant water	0.4–0.6	6.0	2.8	0.012	1.5	1
Copper sulphate and leach-water	0.3–0.4	6.2	3.4	....	1.8	11

In order to be sure that the anodes did not contain the impurity that was causing brittle sheets, we ran a comparative test on the regular anodes and some old ones that were left by the North American Lead Co. The temperature in these tests was approximately 45°C. The acid strength in both solutions was 6% and the copper 3%.

Test No. 5

	Voltage	Copper %	Cobalt %	Nickel %	Iron %	Sulphur %	Lead %	Number of bends
Regular anode	0.6–0.7	56.9	5.5	19.5	9.3	7.0	2.0	1
North American Lead anode	0.4–0.5	62.0	6.0	20.5	4.0	3.0	2.5	2

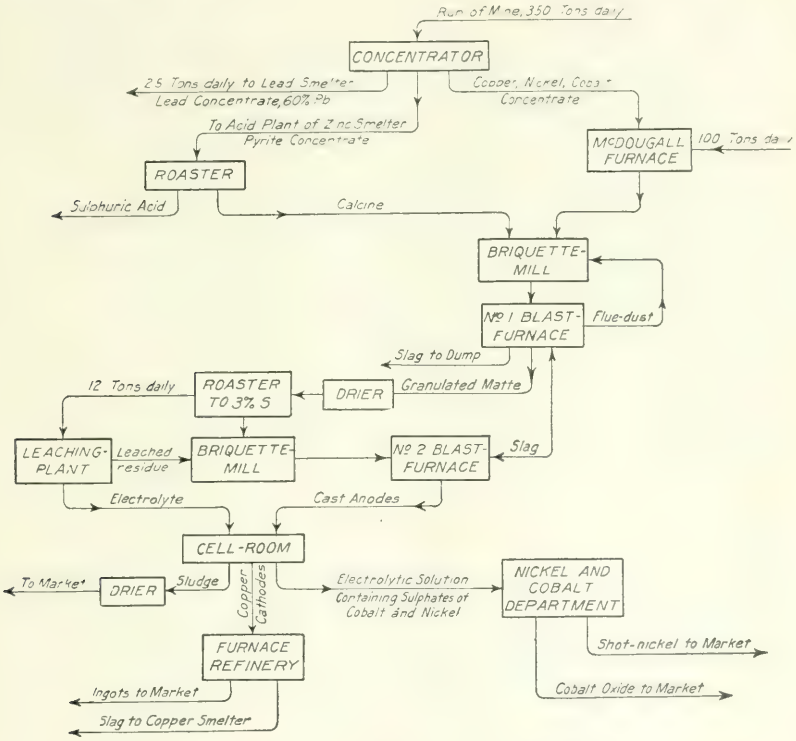


FIG. 1. FLOW-SHEET OF THE MISSOURI COBALT COMPANY'S PLANT

This showed that the water used in the leaching plant was all right, but that the impurity which caused the trouble either was in the matte or entered while the solution was being made up from the matte.

Tests with our leaching-plant acid and with C. P. acid gave us proof that there was nothing wrong with the former.

Test No. 3

The effect of reducing the strength of the free acid was learned

	Voltage	Acid %	Copper %	Chlorine %	Iron %	Number of bends
High acid	0.4–0.6	6.5	3.2	0.01	2.0	1
Low acid	0.8–0.7	2.0	3.0	0.01	2.4	4

Test No. 4

A small amount of glue was added to the electrolyte

	Voltage	Acid %	Copper %	Chlorine %	Iron %	Number of bends
High acid plus glue	0.4–0.5	6.2	3.0	0.01	2.0	3
Low acid plus glue	0.8–0.9	2.3	3.0	0.01	1.9	7

Test No. 6

All conditions same is in Test 5, but glue was added to electrolyte.

	Copper %	Acid %	Number of bends
Regular anode	3.5	2.4	10–12
North American Lead anode	3.7	2.6	12–14

We decided to operate the leaching plant so as to produce an electrolyte with 3% acid and to add the solution-pocket of the head cell of each row half a pint of warm glue solution (25% glue) every eight hours. After making this change the following results were obtained in a 45-day period; blanks placed, 2936; good sheets stripped, 5543; sheets hung, 4346; weight of scrap and trimmings, 6881 lb.; weight of sheets, 24,379 lb. This shows 6% of the total number of sheets scrapped. The remedies for the production of brittle sheets may be summarized as follows:

(1) The spring rains had washed a large amount of salt refuse into the leaching-plant sumps and this was the probable cause of our difficulties. The figures given below seem to show that the troublesome impurities in our starting-sheets were metallic chlorides. An analysis

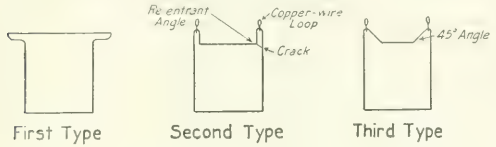


FIG. 2. ANODES

of bad starting-sheets gave copper, 99.517%; chlorine 0.159; and insoluble, 0.144, as compared with 99.707%, 0.017, and 0.094 for the satisfactory sheets.

(2) The glue tended to overcome the activity of the impurities.

(3) The lower percentage of total iron obtained with the low-acid electrolyte, as well as the lower percentage of other impurities extracted gave beneficial results. Ferric iron decreased from as high as 0.5 to 0.1%.

The following data on current efficiencies are given by L. Addicks:

Ferric iron in electrolyte	Current efficiency
0.05	90.0
0.10	80.0
0.15	68.0
0.20	56.0
0.30	35.0

The electrolyte used by Mr. Addicks in this test was 5% acid, 2.5% iron, 3.0% copper, temperature 48°C.

eral tests I used thinner paint than usual on the starting-sheet blanks and found that even under the worst conditions a somewhat tougher sheet resulted. It was decided that more care must be used by the painter in giving the blanks a uniform coating $\frac{1}{16}$ in. thick. The variation in thickness of this coat was sometimes due to a change in the viscosity of the oil. At times I have been convinced that some foreign impurity in the oil or graphite was causing part of our trouble, but I could find no proof. No more brittle starting-sheets, however, were produced after the acid was lowered to 3% and glue added. In connection with the character of the paint used, we found that it was impossible to make use of the standard paint (oil and lamp-black), as our voltage was so high that the copper burned through a thin paint and ruined the blanks for future use. Much thicker oil mixed with graphite was used as a coating and the oily graphitic surface was dusted over the flake-graphite.

The methods of hanging starting-sheets are given below in Fig. 5.

The following data are arranged to compare the work in the cathode-vats with that at Ajo as given by Henry A. Tobelmann and James A. Potter in Vol. LX of the Transactions of the A. I. M. & M. E.

	Ajo	Missouri Cobalt, average for 6 months	
Electrolytic, per minute, gal.	1055	200	
Copper, inflowing electrolyte, %	3.05	3.80	
Effluent solution, %	2.60	0.02	
		High-acid electrolyte	Low-acid electrolyte
Ferric iron, inflowing solution, %	0.38	0.5	0.12
Ferric iron, effluent solution, %	0.94	0.60	0.16
Current density	7.80	10	10

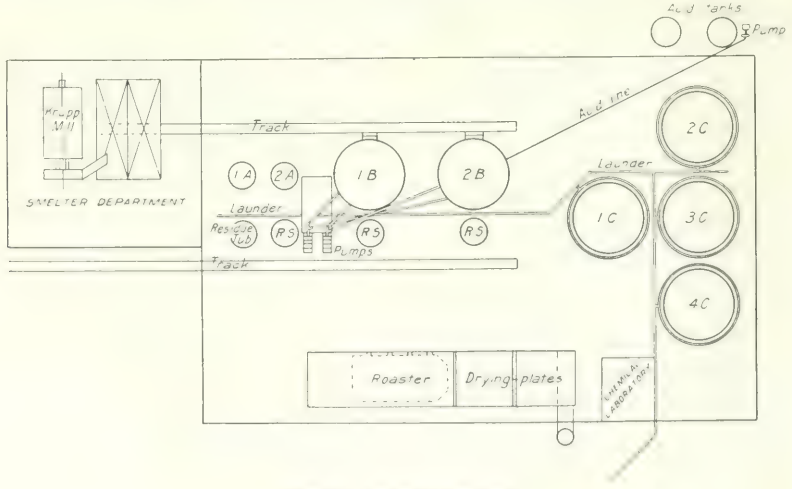


FIG. 3. LEACHING PLANT

The low percentage of free acid permissible in our work was no doubt due to the soluble sulphates. The total of nickel, cobalt, and iron sulphates was at least 20%. The ampere efficiency was not affected by the lowering of the free acid.

(4) The use of thinner paint on the blanks. In sev-

Voltage	1.97	0.7–1.2
Weight of cathode, lb.	117.0	50.0
Number of cells	121.0	90.0
Number of cathodes per cell	22.0	8.0
Number of cells on starting-sheets	24.0	20.0 (low acid, 48 hr.)
Total number of blanks	19...0	160.0
Starting-sheets charged	1...1	90.0
Current to cathodes, Amp.	99.48	99.0
Current, Amp. per cathode	4.60	45.0

Note: Current to cathodes at Ajo, 0.00–0.35

In the operation of the cathode division, 14 men are employed on the day-shift and on each of the others the force consists of a foreman, one circulation-man, and one contact-man. At 7 a.m. the power is cut off for ten minutes to allow the vat-cleaning squad to cut out the ten cells that they are to clean in eight hours. The anodes and cathodes are removed from the two-head cells in the row to be cleaned, and are placed in racks in

soluble copper, cobalt, and nickel that could be extracted by a simple water-wash was determined by a series of tests supervised by J. A. T. Robertson, metallurgist for the company.

	Analysis of dry sludge	Soluble in 5% acid	Soluble in water
	%	%	%
Copper	51.35	1.24	0.50
Nickel	2.63	2.56	2.02
Cobalt	1.03		0.65
Iron	...	2.80	...

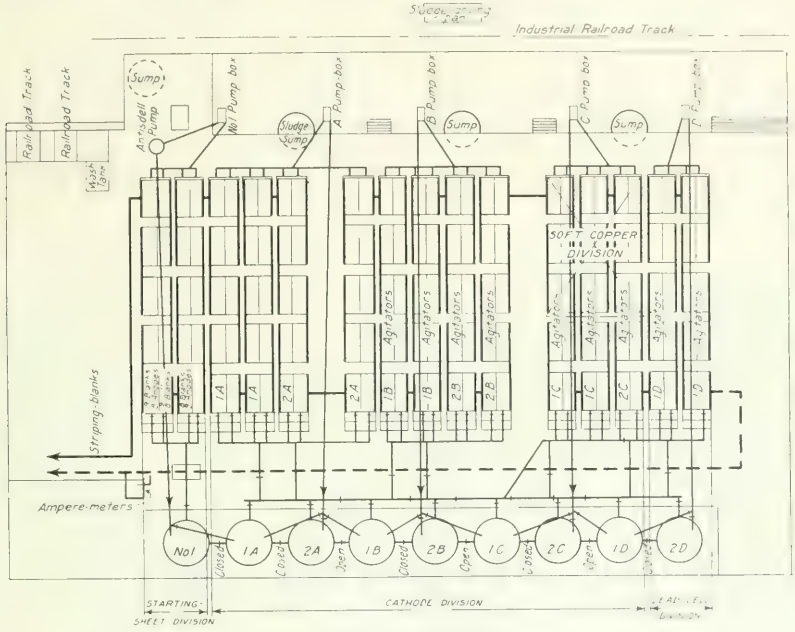


FIG. 4. VAT-HOUSE

order to prevent them from breaking or warping. The solution is then siphoned out of the cells and allowed to flow down onto the floor and thence to a sump. When this sump is full, the solution is pumped to a storage-vat. After the solution is out of the cell, one man, with

The acid does not give any better extraction of cobalt and nickel than water; moreover the acid-wash contains much iron. It would be possible to recover 9.25 lb. of cobalt and 31.15 lb. of nickel per ton of dry sludge by means of a water-wash. Valuing the cobalt at $1 per

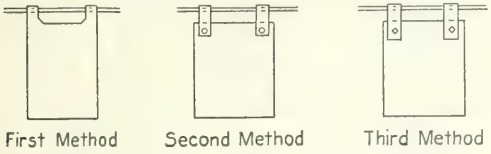


FIG. 5. HANGING STARTING-SHEETS

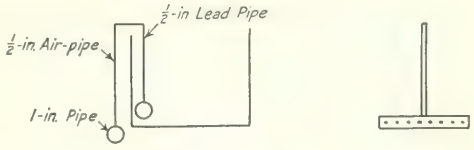


FIG. 6. AGITATORS

rubber boots and gloves, gets into the cell and scrapes the sludge through a 2-in. hole with a wooden shovel. Each cell has two of these holes plugged with lead stoppers having rubber washers. The sludge drops into a launder, which leads to a box where the excess solution is drained into the sump; the operator shovels it from this box into a wooden wheelbarrow and removes it to a wood-fired drying-pan. It takes 24 hours to dry two to three tons of sludge on this pan. The amount of water-

pound and nickel at 25c. per pound, a saving of at least $17 per ton might be effected as well as a reduction in penalty of two units of cobalt and nickel. This had not been done up to the time I left the plant.

The men who cleaned the vats removed the 40-lb. cathodes and placed the starting-sheets and the new anodes that were required. They left 10 cells at 3 p.m. in first-class condition as far as electrolysis was concerned. Each vat was cleaned twice a month. If we

had been able to run continuously we would have made cathodes in 15 days and all 'pulling' of copper would have taken place when the vats were cleaned.

The head circulation-man's duty was to go over all solution-pipes from the feeders to the overflows into the pump-boxes in order to keep the rate of circulation at a maximum. The contact-man watched the voltages and corrected irregular readings by shining contacts, removing 'berries' and broken pieces of anodes or cathodes.

The handling of anodes in the cell-room was done by a small ½-ton crane with ordinary spider for moving anodes and cathodes.

Under the new scheme the 3%-acid electrolyte was passed through the head cells of the starting-sheet rows and flowed from there to the A, B, C, and D cells respectively.

Below are given typical analyses of the electrolyte as it flowed through the plant.

	Acid %	Copper %	Iron %
Effluent from leach-plant	2.8	3.5	1.0
From starting-sheet cells	3.0	3.1	1.2
A cells	3.2	2.7	1.39
B cells	3.7	1.9	1.52
C cells	4.0	0.07	1.73
D cells	5.1	0.016	2.0

The Antisdell pump lifting the starting-sheet solution could discharge into either No. 1 and No. 1A vat. The leveling-valve between the two was kept closed. The pump handling electrolyte for the four A rows discharged into 2A vat. The leveling-valve between No. 2A and No. 1B was left open,. The A cells were fed from No. 1A vat. The solution was pumped back to No. 2A, leveled into No. 1B and the B cells were fed from No. 1B vat, pumped back into No. 2B, and leveled into 1C. The C cells were fed from No. 1C, pumped back into No. 2C, and leveled into No. 1D. The D cells were fed from No. 1D and pumped into No. 2D. The solution entering 2D was ready for the cobalt-nickel department.

The head cells of the C rows produced hard cathodes with a 3% acid electrolyte. The agitators used are shown in Fig. 6. These agitators reached below the anodes and cathodes, and the results obtained were highly satisfactory. The proportion of soft copper was reduced from 35% to 8%, and although the agitators required considerable attention this was more than offset by the reduced handling of soft copper. Soft copper was produced in the lower 18 cells.

To increase the amount of electrolyte in circulation and the period of contact of the electrolyte with the cathodes, pipes between the cells were replaced with open lead launders.

The following comparative data show the results from changes made in the lead-cell division.

	December 20 to April 1	April 1 to July 1
Acid in [illegible], %	0.4	1.0
Copper in solution sent to the nickel-cobalt department, %	0.4	0.01
Iron in solution sent to the nickel-cobalt department, %	4.3	2.0
Daily [illegible] to nickel-cobalt department, tons	100	200
Nickel in solution, %	0.7	1.2
Cobalt in solution, %	0.1	0.2

These changes in the quality of the products delivered to the nickel-cobalt department were due to additional circulation, agitation, clean lead sheets, and vats free from sludge. The high-acid solution in these cells was hard on pumps. The D pump, for example, was repaired at least once every 24 hours.

From my experience in this plant, I suggest the following improvements:

(1) The use of Antisdell pumps for handling electrolyte.

(2) The use of solid bus-bars.

(3) Protection of all wood vats and cells with antimonial lead.

(4) The washing of copper sludge for soluble metal.

(5) The use of asphalt covering on cement floors and vat-bases where lead caps are not used.

(6) The handling of sludge in lead-lined buggies from the discharge of the cells to the drying-pan.

(7) Where circulation pipe-lines become clogged with crystals, the use of steam to keep all solutions at the same temperature. If this is not adequate the use of open launders, if possible.

(8) The use of air-agitation and increased circulation in cells operating with electrolyte under 2% copper.

(9) The use of insulators of the Ajo type on all lead anodes and cathodes.

Furnace Refinery. Up to January 1919, the company had not made any refined ingot copper. However, I started a small 10-ton furnace, which was a relic from the North American Lead Co.'s operations and a good furnace considering its size.

It was necessary to break-in an entire crew of furnacemen and ladlers. The only men that I had to draw from were farmers, whose lack of experience caused many expensive accidents before they became efficient. At first the furnace was equipped with oil-burners, but the use of oil, owing to the poor system of circulation, was expensive and gave poor results. Coal-firing, with a forced draft under the grate-bars, proved better. The copper was ladled with small 8-in. wrought-iron ladles requiring four men. It took about four hours to ladle six to eight tons of refined ingots.

The ingot copper, containing 0.02% nickel and 0.001% cobalt, was medium-grade casting copper assaying about 99.7%. The furnace operated only about 10 days per month, owing to the small production of electrolytic copper. During the first months the cost of brick and bricklaying amounted to one-third the cost of refining copper. For this reason, I discontinued the use of the smelter bricklayers and broke-in the furnace-men for this work with considerable saving. C. B. Underwood, who was then assistant superintendent of the furnace refinery, was responsible for a considerable reduction in the cost of the refining.

My opinion is that a metallurgical method is available for the profitable treatment of this ore. Frankly, I believe that the Missouri Cobalt Co. made the mistake of spending too much money and time on the extraction of nickel and cobalt, instead of first realizing on the copper and in the meantime working out, in a small test-plant, a scheme for the recovery of nickel and cobalt.

Early Days on the Rand

By J. E. CLENNELL

It was in the year 1854 that the earliest recorded discovery of gold was made in this district. In that year it was announced that one Jan Marais had made a find at the Yoke-Skey river, a tributary of the Crocodile, or Limpopo, and had also observed the precious metal on the Witwatersrand, the range of hills which forms the main watershed of the country. Some nuggets were exhibited at Potchefstroom, but there the matter seems to have dropped, for we hear no more of gold being sought for in this part of the Transvaal until 1883, seldom remarkably rich. It was soon noted that these deposits were extensive, and that the gold was distributed in them with remarkable uniformity.

In November 1885 J. Bantjes began prospecting on the farm Roodepoort, and struck what was afterward known as the 'Main Reef', and in December Struben erected a 5-stamp mill, with which he and Bantjes crushed 50 tons of conglomerate in March 1886. The Main Reef was also uncovered by Walker on the farm Langlaagte and then Struben and Bantjes struck it again on Vogelstruisfon-

COMMISSIONER STREET, JOHANNESBURG

nearly 30 years later. In December of that year, Frederick Struben noticed the gold-bearing formation of the Witwatersrand, and in January 1884, he began prospecting on the farm Sterkfontein. In April of the same year he was led to suspect the probable presence of gold-bearing conglomerate, from the occurrence of water-worn pebbles on the highest parts of the range, but it was not until September 1884 that a lode was struck east of Sterkfontein, assaying 913 oz. gold and 362 oz. silver per ton.

The conglomerate formation now known as 'banket' was first noticed in March 1885. The word 'banket' (pronounced bon-ket, with the accent on the second syllable) is the Dutch name for 'almond-rock', a sweetmeat to which the rock in question bears some resemblance. It consists of hard white round or oval pebbles imbedded in a friable darker matrix, which carries the bulk of the gold. The banket sometimes shows visible gold, but is tein. These discoveries began now to attract attention, and many other persons started prospecting, some of them on the spot that became the site of Johannesburg.

In May 1886 Col. Ferreira informed the Government of the presence of gold on the Gatsrand, a parallel range of hills, south of the Witwatersrand. On July 18, nine adjoining properties were proclaimed by the Government as forming the Witwatersrand goldfield. About the same time the Ferreira and Natal camps, the nucleus of the present Johannesburg, began to spring up. The Main Reef was found to run through the ground occupied by Ferreira's camp; the houses were accordingly demolished and fresh building-sites sold to the inhabitants in what is now Johannesburg proper. On September 20, a plan of the new township was advertised by Captain Von Brandis, the Landdrost, or special magistrate appointed by the Government, and on December 8 of the same year the first sale of building-sites took place,

realizing £13,002. This may be considered to mark the foundation of the present city of Johannesburg.

The growth of the town from that date to the beginning of 1889 was probably without a parallel even among the annals of American and Australian mining settlements. At the time of my arrival, in March 1889, there were probably well over 20,000 inhabitants, whose dwellings of brick, iron, and wood extended over a mile from east to west and nearly as far from north to south. Little more than two years before, nothing would have been visible save a boundless expanse of green veldt, broken by ranges of rocky hills, with here and there a prospector's tent, or a few miserable hovels of unburnt brick, rudely covered with thatch, canvas, or a sheet of corrugated iron.

Every day saw coaches, mule-carts, ox-wagons crowded with newcomers, flocking in from all quarters. The older towns of Cape Colony and Natal, and also Kimberley, Barberton, and other once flourishing mining centres were being rapidly drained of their wealth and population to swell the ranks of the goldseekers on the Rand. The difficulty experienced by newcomers in getting sleeping accommodation was incredible. A night or two in a bullock-wagon or on a billiard-table was no infrequent experience, and there were many who gladly paid 35 or 40 shillings a week for a miserable truckle-bed in a tiny corrugated iron shed, with three or more others in similar plight for companions. Happy was he who, by a plentiful application of 'Keating', could secure immunity from the too-pointed attentions of the nimble tribe, and could also escape that other too frequent boarder who has won such renown in the recent war, and who has been aptly described as 'slow, but steady of purpose'.

In the outlying townships, such as Doornfontein, Jeppestown, and Booysen's, suburban villas with some pretensions to elegance and luxury were springing up, to form pleasant retreats for those who should win fortune in the great gamble. A splendid general view of Johannesburg could be obtained from any of the heights to the north and east, and a most impressive effect was produced by the immense variety of buildings with their metal roofs flashing in the sun, the spacious squares with scores of laden wagons, and along the southern edge of the town, the headgear of numerous shafts, the battery-sheds, workmen's and staff dwellings, stretching in a continuous line along the course of the Main Reef.

The life and activity of Johannesburg was mainly concentrated in the neighborhood of the market-square, which in a South African town fills the rôle of the plaza in Mexico and other Spanish-American countries. Running east and west, south of the square, was Commissioner street, the main thoroughfare, containing many of the principal stores, shops, and offices. The financial heart of the city, the Exchange, was accommodated in a somewhat imposing white stone building in a short street joining Commissioner street with the market-square, but much business was transacted in the open air 'between the chains' in front of this building, where an animated scene was generally to be witnessed as the excited crowd surged to and fro discussing the latest movement of 'Kaffirs', while from time to time a stentorian voice would make some modest announcement such as "I'll sell 'Cities' at 15!"

To the east of the market-square, a large block of buildings with a façade of white stone housed the Post and Telegraph offices and other Government departments, which at that time were much under-staffed. The telegraph service was notoriously bad and important busines with Capetown and Kimberley was frequently carried on by letter rather than risk a wire that might be cut at any moment by some enterprising speculator with reasons of his own for depriving the outside world of all knowledge of the existing condition of the market.

In the centre of the Square was a large red-brick market-house, in which the sale of fruit and vegetables was conducted at prices that (before the War) would have turned a London or New York fruiterer green with envy. Many large produce-stores surrounded the square.

Galvanized iron, that unsightly and uncomfortable building material, was everywhere much in evidence, but good building-stone had already been quarried at Doornfontein and a company had been formed for brick-making on a large scale. Masons and carpenters were paid 30 shillings per day, which in those happy days was looked upon as an extravagant wage.

Immediately before the date of my arrival, the Rand had experienced its first 'boom'. Speculation in stocks and shares presented far greater attractions than the legitimate development of the mines, and although many of the properties were already of proved merit, many others were placed on the market with nothing to recommend them except some attractive title, or the neighborhood of some well-known property.

Soon afterward metallurgical difficulties began to develop, and on reaching the pyritic ore it was found not only that the cost of crushing was increased but that the recovery of the gold by amalgamation was sadly diminished. Many croakers began to despair of the future of the goldfield and the inevitable 'slump' set in, which became acute in 1890. Many deserted the camp, and it was mainly the introduction of the cyanide process that saved the situation by solving the problem of treating the ore from the lower levels.

One of the chief difficulties with which this goldfield had to contend was the cost and delay of transport. The nearest point to which the railway extended was Ladysmith in Natal, some 250 miles from Johannesburg. Kimberley was about 300 miles away. An ox-wagon, with a load of ordinary merchandise, frequently took six weeks to perform the journey from the rail-head to Johannesburg. All heavy crushing machinery came from England or America, and as may be supposed, a long interval elapsed between an order and the delivery of the goods, though even in this respect, the Witwatersrand had an advantage over Barberton and other more remote districts. White labor at the mines received from £3 to £6 per week, while the Kaffirs got 10 to 15 shillings, and the cost of mining and milling was reckoned at considerably over £1 per ton.

Another advantage that the Rand enjoyed was the

presence of large deposits of coal close to the banket formation, at Boksburg, 12 miles east of Johannesburg, and at other points in the neighborhood. Many rich deposits in other parts of South Africa were unworkable for lack of fuel. The country round Kimberley had been denuded of trees to supply the wants of the diamond mines and in the rugged country about Barberton the transport of fuel was costly and difficult. A project was already on foot for building a light railway between Johannesburg and the coal mines. For political reasons, since the Boers dreaded the introduction of railways in the country, this line was always called the Rand Tramway.

The goldfield was further blessed with an abundant supply of water, since the Rand was the source of innumerable streams that go to swell the Vaal or the Limpopo. In some instances the mine-water sufficed for milling purposes; in many places were *vleis*, or marshy ponds, which gave no abundant supply, and large dams had been constructed, notably at Knight's, later known as the Witwatersrand mine, to conserve the natural flow. On the other hand, there was not sufficient fall to admit of the utilization of water-power for mining or milling purposes.

Two small companies were working on alluvial gold, and a rich strike of ore, of a character somewhat different from that of the ordinary banket, had been made at the Black Reef, some eight miles south-west of Johannesburg.

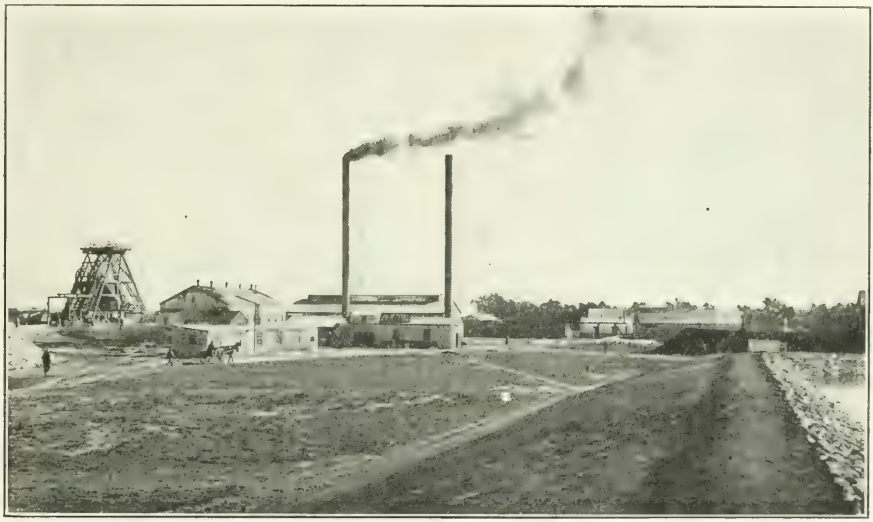
The largest battery on the Rand at that time was that of the Witwatersrand company, which had 100 Sandycroft stamps, and a new 60-stamp mill, which was then considered a model of excellence and efficiency, had just been started at the Langlaagte Estate, erected by Fraser & Chalmers.

The Main Reef Leader, a rich but narrow deposit parallel to and south of the Main Reef, had been struck on the City & Suburban property, just east of Johannesburg.

Situated at an elevation of nearly 6000 ft., with a fairly dry and bracing climate, with no great extremes of temperature, one would have expected to find Johannesburg a healthy spot. Nevertheless, a good deal of sickness prevailed, chiefly what was called 'camp fever', which was generally supposed to be a mild form of typhoid. The sanitary arrangements of the town were then, and for a long time afterward, in a disgraceful condition, and this, added to the frequent dust-storms of the dry winter, no doubt helped to spread disease.

Frosty nights and cold windy days were quite usual during the winter, say, from May to August, and in the summer a short spell of heat would be followed inevitably by frequent and violent thunderstorms. These were sometimes preceded by squalls of wind that filled the air with red dust, giving for some time a fair imitation of a genuine London fog. The dust penetrated everything, so that all objects in-doors and out would assume a uniform reddish hue. It lay in drifts on the roads, filling the many holes and ditches. The effect after the heavy rain, which usually followed, may easily be imagined.

Life in the Johannesburg streets, especially at night, was not altogether without its excitements, although the 'tenderfoot' usually managed to acquire an exaggerated idea of the dangers awaiting him. At that time there were no street-lamps, but as there was usually a bar in full blaze at each of the four corners of every street-crossing, their absence was not such a serious inconvenience as might have been supposed. Burglaries and street robberies were not unknown, but in general the



RANDFONTEIN CENTRAL MINE

streets were remarkably quiet, though no doubt many lively scenes were being enacted within the aforesaid bars. These establishments usually displayed the notice "All drinks sixpence except Three Star". Other liquids, however, were procurable, as the town had already been furnished with a good supply of water for domestic purposes.

Apart from the Stock Exchange and the bars, the chief place of entertainment was the race-course, within easy reach of the town, where the sport was carried on with much enthusiasm under the patronage of the Turf Club. North-east of the town the cricket-ground of the Wanderers' Club was a great attraction. Two theatres had already made their appearance; this, of course, was long before the days of the 'movie', but the 'variety shows' of the music-halls was a more popular form of entertainment than the 'legitimate' stage. Occasionally, however, a good theatrical company would visit Johannesburg, and full houses was the rule.

A project was on foot for establishing a free library and reading-room, and a number of clubs and masonic societies had their meeting-places. Churches had already been built for the following denominations: Church of England, Roman Catholic, Wesleyan, Baptist, Presbyterian, and Dutch Reformed. In the last the service was conducted in the Dutch language. Most of these churches had schools attached to them.

A hospital had been erected on the northern heights at a little distance from the town, on what became known as Hospital hill, but the accommodation was already insufficient and a new building was being planned, to be erected near the same site.

Four seemingly flourishing daily papers made their appearance, namely, the 'Transvaal Mining Argus', the 'Daily News', the 'Standard', and the 'Diggers' News'. The two latter became amalgamated. The 'Eastern Star' also rose every alternate day. These papers for the most part represented the interests of the 'Uitlander', or foreign settler, as opposed to the 'Afrikander', or Boer element, between whom relations were none of the best already. The conservatism and primitive habits of the Boers provoked the ridicule of the newcomers, whereas the old established settlers, mainly of Dutch descent, were animated by a spirit of arrogance engendered by their apparently easy victory over the 'rooi-nek' in the war of 1880-'81. A great and not altogether unjustifiable opposition was displayed to the opening up of the natural resources of the country by hordes of not very desirable immigrants. Yet as many of these brought much money into the country, the Boers were not slow to reap what advantage they could, in the way of taxes and imposts of all kinds, and by heavy charges for transport and such agricultural supplies as the country afforded.

The old Boer transport rider, with his long train of oxen (eight or nine pairs in a span), his great slouch hat, and formidable whip, was a most picturesque object. A long iron chain connected the pole of the wagon with the foremost pair of oxen, the wooden yokes being affixed at intervals along this and secured to the necks of each pair by loops of rope or leather. A small Kaffir boy—the 'voor-looper' guided the movements of the foremost animals, and kept watch over them, usually lying for hours face downward in the dust of the market-square, while his master haggled over the disposal of his produce.

The Kaffirs employed at the mines were of many different races, and tribal fights were by no means uncommon. I have myself witnessed several spirited combats of this kind. The opposing parties would establish themselves on neighboring mine-dumps, and after a prolonged period of mutual recrimination and vituperation, would make a simultaneous charge followed by a scrimmage in which 'knob-kerries' would crash unceasingly on unyielding craniums. Zulus, Basutos, Shangaans, Fingos, Matabele, and other tribes contributed their numbers to supply the unskilled labor of the goldfield, attracted by the hope of earning, in a few months, the means of providing themselves with such a supply of cattle and wives as would obviate the need for further work on the part of the lord and master. Needless to say, these dreams were not always realized, and many fell victims to drink, to insufficient shelter from the rigors of the climate on the high veldt, and to the many vices and diseases that they acquired by contact with white 'civilization'.

THE ANAKIE SAPPHIRE FIELDS in Queensland had a profitable year during 1919. Never before has the price of gem stones risen so high, and never have so many buyers been doing business on the fields. While at the beginning of 1919 prices, generally speaking, were slightly higher than before the War, toward the middle of the year they steadily mounted, until the value of ordinary 'parcel' blues had, on the average, doubled. For large corundum, for which there was a keen demand during war time, the price has not varied much. It is said that in the present chaotic state of some European countries many people, having lost faith in paper money and scrip, are converting their assets into gems as having an international value. It is also stated that, since lapidarian workshops have been established in Great Britain during the War and the gem industry has assumed larger proportions in France, the cutting and distribution of sapphires is no longer, as it was, practically a monopoly of the towns of Idar and Oberstein, in Germany, and that consequent competition between old and new establishments tends to increase the demand and raise the price of rough stone. There has been a gradual rise in the price of stones since 1900.

GOLD has been found in the beds of rivers rising in the Carpathians, but they have as yet not been prospected. Particles of gold up to 2.35 carats have, however, often been found in the washings of the Oltul. In the district of Ramnicu-Valcea workings of an experimental nature were begun in 1912. The ore gives from 15 to 30 gm. of gold per ton, but the known reserve of this grade is only 3000 tons. These deposits present but a scientific interest, as yet no serious work having been undertaken to arrive at their practical importance.

Pulverized Coal in Metallurgical Furnaces at Cerro de Pasco

By OTIS L. McINTYRE

*The Cerro de Pasco Copper Corporation at La Fundicion, Peru, uses about 65,000 tons of coke per year, of which about 85% is local coke made at the smelter, and 15% is imported. This latter is very expensive, and of course both classes of coke enter largely into the smelting costs; consequently, about two years ago it was decided to determine what could be done in the way of using pulverized coal in the various departments of the smelter. The preliminary work consisted in determining the general combustibility of the local coals in pulverized form. These coals are obtained from two mines operated by the company and have the following general analysis:

Ash, 26.8%; volatile material, 40.05%; and fixed carbon, 33.15%.

This coal was dried by hand on steam hot-pans to less than 1% moisture, and then ground in a 4 by 4-ft. Marcy mill, the product being stored in barrels until a sufficient quantity had been pulverized to run a test. An average screen-test of this pulverized coal was about as follows: on 60 mesh, 8%; on 100 mesh, 8%; on 200 mesh, 14%; through 200 mesh, 70%.

The equipment used in the test is shown in Fig. 1-A. It consists of a coal-hopper, a 3-in. feed-screw driven by variable-speed motor, and a No. 2 Sturtevant blower supplying the air. The burner was a standard 6-in. pipe projecting about 12 in. into the furnace, which was approximately 4 by 4 by 16 ft. and constructed of firebrick. A number of tests were run with this equipment and though no pyrometric measurements were taken, observation of the furnace showed the results to be satisfactory.

The tests were first made with pure pulverized coal, and then with mixtures of coal and coke breeze, varying from 10 to 35% breeze, which gave practically the same results as did the pure coal. The lay-out was then changed, Fig. 1-B, to test the practicability of using more than one burner with a single feeder. This test was run with the 4-in. return pipe, first open and then closed, the results indicating that satisfactory operation could be obtained by either method with a properly proportioned system of pipes.

The next test made was in the sintering of fine ores on a standard Dwight-Lloyd sintering machine. These machines are oil-fired, and if coal could be substituted it would effect a considerable saving. The equipment used in this test was the same as shown in Fig. 1-A, except that a 1-in. screw-feeder, a smaller fan, and a 2-in. pipe burner were used. This test produced a satisfactory sinter, though some trouble was encountered in the primary ignition of the coal, and the standard oil-muffle proved to be too small.

The next experiment was to test the feasibility of conveying pulverized coal under direct-air pressure. The lay-out used is shown in Fig. 2. Pulverized coal was placed in the pressure-tank and air at 20 to 25 lb. was then admitted through the ¾-in. pipe at the top of the tank. The 4-in. valve at the bottom was then opened and the coal passed through the 4-in. piping system to the coal-hopper. In this way 4000 lb. of coal was transported in from 1½ to 2 minutes. The loss through the vent-pipe varied from 100 to 200 lb. This can be taken care of by using dust-collectors on the hopper, or an exhaust system which would return this waste coal to the main hopper.

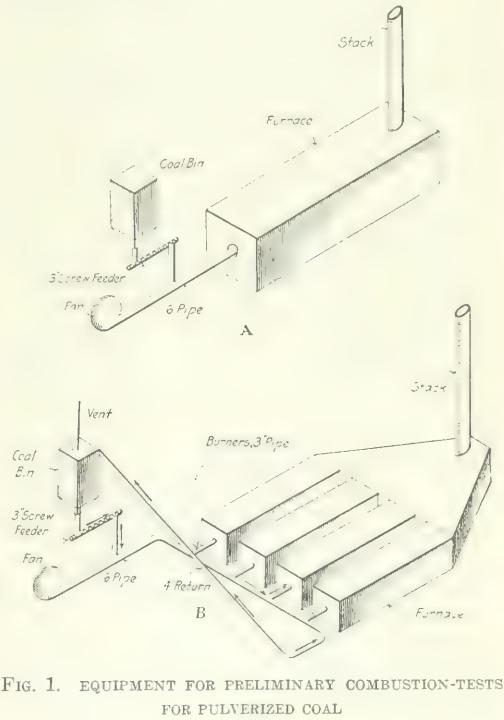


FIG. 1. EQUIPMENT FOR PRELIMINARY COMBUSTION-TESTS FOR PULVERIZED COAL

The foregoing tests were so favorable that it was decided to erect a larger experimental pulverizing-plant. There were available for this purpose one set of 18 by 36-in. rolls, one 4 by 4-ft. Marcy mill, and two 6 by 4-ft.

*A paper presented before the American Society of Mechanical Engineers at St. Louis, in May 1920.

Allis-Chalmers ball-granulators. The drier consisted of five passes of 16-in. by 12-ft. screw-conveyor, mounted in a brick housing on top of the reverberatory flue, through which part of the flue-gases were by-passed.

After completing this plant it was decided to make the first experiment on the blast-furnaces, so No. 5 furnace was selected for the purpose and was equipped on one side only, as shown in Fig. 3. The coal was ground at the experimental plant and transferred to the No. 5 furnace in a hopper-bottomed car, being weighed in transit. A number of tests varying from 8 to 12 hours were run with this equipment. The air-pressure in the furnace averaged 34 oz., and auxiliary air for injecting coal about 22 lb. The charge of coke was reduced first 25% and then 50%. These tests were so encouraging that it was decided to equip the other side of the furnace with coal-feeders and run a test of several days' duration. This was done and the results were entirely satisfactory. During these tests the auxiliary air was taken from the converter air-line, which varied from 12 to 16 lb. pressure. The following quantities will give an idea of the proportion of coke and pulverized coal used:

Length of run, hours	14	50
Normal charge of coke, lb.	31,000	114,000
Actual charge of coke, lb.	17,000	61,800
Pulverized coal fed to furnace, lb.	8,900	41,000

The analysis and screen-tests of the coal used were practically the same as noted above. The performance of the furnace during all tests was carefully observed and was found to be fully equal to that when operating on the normal coke charge. Two difficulties were experienced on the blast-furnace test: namely, keeping some to the feeders in operation and keeping the tuyeres open. It was observed that in some of the feeders there was a slight back-pressure, due probably to partly blocked tuyeres. This did not affect materially the feeding, but forced some coal-dust into the feeder-bearings which mixed with the oil and finally bound the bearings so that it became necessary to shut-down that particular feeder and clean the bearings. This was easily done without stopping the other feeders, as the gears on the main shaft were mounted on feathers and provided with shifters. By using dust-proof bearings and a better-designed injector, we expect to eliminate this trouble.

Keeping the tuyeres open is absolutely essential to the safe and efficient operation of this process, and as it is a manual operation it must be handled by the operators. During these tests, tuyeres were 'punched' every 15 to 20 minutes on signal. On one occasion a tuyere became badly blocked, the feed was cut off and the tuyere-cap opened. The blast from the furnace blew out a dense cloud of coal-dust and molten material. The dust was ignited and burned on the outside of the furnace for 20 to 30 seconds with an intense flame about six feet long, the tuyere acting as an ordinary coal-burner. In view of the difficulty of keeping the tuyeres open and the connections air-tight, it is probable that the most satisfactory place to inject the coal into the furnace would be through a separate opening in the jackets, between and preferably somewhat above the tuyeres.

The No. 5 reverberatory was selected for the final test. All four reverberatory furnaces in use are identical: they are old-style, designed for hand-firing, and about 18 by 58 ft. inside the bridge-wall. The coal was discharged from the last mill into a hopper and dropped into a 7-in. pipe where it was picked up by an air-jet and conveyed to the coal-hopper, a distance of about 80 ft. with a rise of about 30 ft.; the top of the hopper was constructed similarly to a cyclone dust-collector. From the hopper a 6-in. variable-speed screw-feeder fed the coal into the suction side of a No. 9 Sturtevant Monogram blower; this in turn discharged the mixture of coal and air into the feed-piping from which branched five 6-in. pipe-burners into the furnace, the excess air and coal returning to the hopper.

The results of this test were disappointing, but when the following difficulties are corrected, the furnace will, beyond question, show a higher efficiency than the hand-fired furnace. First, the coal could not be dried sufficiently, the average moisture being in excess of 1.5%. This introduced difficulty in handling. The plant would not grind sufficient coal to the required fineness, the average screen analysis being: on 65 mesh, 22.8%; through 65 mesh, 8.5%; through 100 mesh, 25.6%; through 200 mesh, 42.4%.

Furthermore the discharge from the hopper to the feeder was too small, and the coal continually caked and bridged. The screw-feeder was so short that the coal flushed badly at times; also the discharge from the feeder was too far from the fan so that the coal accumulated in the suction-pipe and had to be removed with an air-jet. Under these conditions it was obvious that uniform feeding, which is essential to efficient operation, was impossible.

This test covered nine days, and was run for two days with the return-pipe open. Some time during the second day the return-pipe was blocked, due to overfeeding, and it was decided to continue the test without opening the run-pipe, the only difference being an apparently heavier feed at the burner farthest from the fan. With a properly designed piping system there seems to be no reason why a series of burners cannot be operated from a single feeder with or without a return. The last day's run of this test was made with a mixture of 75% coal and 25% coke breeze, which gave results equal to straight coal.

The following table shows a comparison between the average performance of reverberatories No. 2, 3, and 4, which were hand-fired, and No. 5 over the same period:

	Average of—	
	2-3-4	5
[illegible]	5.35	4.63
[illegible]	2.00	1.99
[illegible]	2.07	2.33
[illegible]	.262	.225
[illegible]		.37

These results are really not so bad when the troubles experienced are considered and it is remembered that this furnace was not designed for pulverized coal, that it cools very rapidly during any shut-down, and that considerable time is required to bring it up to the smelting temperature again.

As accumulations of ash are an important factor in

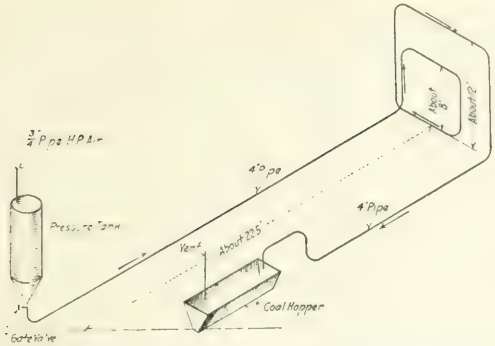


FIG. 2. EQUIPMENT FOR TESTING FEASIBILITY OF CONVEYING PULVERIZED COAL BY DIRECT AIR-PRESSURE

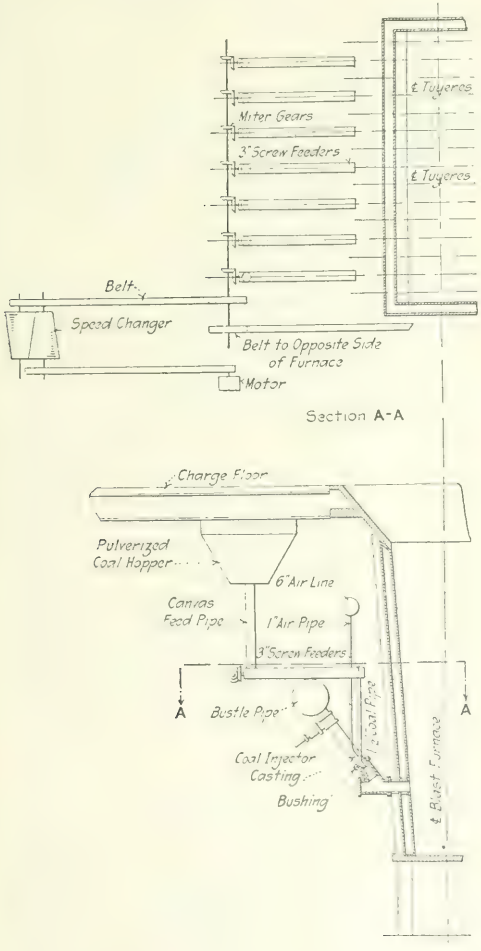


FIG. 3. EXPERIMENTAL EQUIPMENT FOR USING PULVERIZED COAL ON NO. 5 BLAST-FURNACE

reverberatory smelting with pulverized coal, close observation was made of these accumulations, and the following samples were taken:

1. Ash and slag float on the bath: comes out when skimming in small and large pieces, sometimes has to be broken to pass the skiming-door, is easily handled when furnace is hot, but is tough and sticky when furnace is cool.

2. Ash in boiler cross-flue: spongy mass of ash and some slag accumulates in fairly large quantities in cross-flue between furnace and waste-heat boilers; is soft and easy to remove when first deposited, but if allowed to remain, is difficult to remove.

3. Ash on sides and roof of furnace: almost pure ash, lightweight and brittle when cold, appears to accumulate on sides and roof of furnace until too heavy to stick, when it drops and floats on the bath.

4. Ash in reverberatory flue, similar to No. 2.

Quite a large quantity of ash was deposited during each shift on the boiler-tubes, but was easily blown off by compressed air once or twice a shift. It was estimated that at least 50% of the total ash was disposed of in the manner described, while the remainder was deposited in the main flue and went up the stack.

As a result of these experiments a modern 250-ton coal-pulverizing plant was designed and is now in course of erection. Blast-furnaces, reverberatories, and sintering plant will be equipped for pulverized coal, and the experiments will be continued to ascertain the equipment most suitable for local conditions, which will then be used at the new smelter now being constructed. In conclusion, it may be of interest to note that these experiments and tests were carried out at an elevation of 14,200 feet.

THE Bering River and Matanuska coalfields in Alaska, according to a report of representatives from various government departments, contain high-grade bituminous coal much better than that on the Pacific seaboard, as well as some anthracite. The coal is closely folded and much broken, making it expensive to mine, and rendering it in part unavailable for present profitable exploitation. There are, however, in both fields, high-grade coal that can be mined and these will find an export market. Until they have been more thoroughly prospected by underground exploration, it is not possible to predict their annual tonnage. The committee says the development of Alaskan coalfields is of first importance, and recommends that it be encouraged by making the terms of leases as liberal as the law will allow; that underground explorations in the Matanuska coalfields be conducted with vigor by the Government; that companies engaged in prospecting the Bering River coalfield be encouraged to develop coal; that the departments give immediate consideration to the desirability of establishing a coaling-station for commercial and naval use at a port in the Aleutian Islands suitably situated to serve Trans-Pacific shipping; and that the Alaskan coal-leasing law be modified so as to allow a prospecting period of four years before a lease is signed.

The Las Chispas Mine, in Sonora, Mexico

By FERNANDO MONTIJO Jr.

The Las Chispas mine is near the town of Arizpe, and about 40 miles from the railroad at Nacozari, Sonora, by pack-trail through difficult broken country. There are several roughly parallel veins in the same spur of the Sierra, none of which, except Las Chispas, and Guillermo Tell, has been explored systematically.

Near the mine the surface shows old lavas, tuffs, and breccias, with an occasional patch of conglomerate. The Chispas vein occupies a fault-fissure that has a north-west-southeast strike. It has been explored by mine-workings through a number of layers of breccia and tuff, locally called *mantos;* these are closely related in mineral composition and about 600 ft. thick in all. Next the vein penetrates a light-gray dense rock, megascopically felsite-porphyry, extrusive, followed by a pink felsite-porphyry, together about 200 ft. thick. Then comes less than 100 ft. of No. 2 breccia, and No. 2 felsite, of unknown thickness and as yet unexplored except by a shaft outside the vein. These formations, throughout the length of the mine, occupy a gentle syncline.

A basaltic dike, dark-green, with numerous small crystals of pyrite, cuts nearly vertically, through the formations. This dike is anterior to the vein-fault. A number of minor cross-slips (crosswise in relation to the vein) and one major cross-fracture are posterior to the dike but anterior to the vein-fault. There is no evidence of further faulting posterior to the vein. The dike is first cut in cross-cut 619E (of the adit-level) at a distance of 110 ft. north-east of the vein. At station 627 it was found at a distance of 15 ft. from the vein. At station 629 the vein crosses the dike, both running together, however, for a distance of 35 ft. The angle between dike and vein at the point of crossing is about 11°. From here the dike is not again cut until station 648, beyond the largest cross-slip, is reached. Here vein and dike touch tangentially for about 40 ft. Finally, the dike is met 28 ft. south-west of the vein in the 650 or Dolores cross-cut. These relations are shown in Fig. 1. The vein-fissure is continuous throughout its explored length; the only effect the dike has upon it is to deflect its course at the crossing where both run together for 35 ft. and again where both touch tangentially for 40 ft. The dike is faulted by the small cross-slips, but not the vein.

The economic minerals are native silver, silver chloride and argentite mainly in the upper breccia; argentite, polybasite, stephanite, and ruby silver in the felsites below. Interior shafts extend into the lower breccia and No. 2 felsite, but outside the vein. At the 800-ft. or deepest level we are near the lower contact of the upper felsites, in the zone of secondary sulphides. Besides the silver sulphides, the ore contains pyrite and a very small quantity of zinc, lead, and copper sulphides, besides antimony, of course, in the polybasite and stephanite. The gangue is quartz, clay, very little calcite, and fragments of country-rock. A typical analysis of shipping ore gives the following proportions of metals: silver, 350 oz. per ton; gold, 2.75 oz.; lead, 0.7%; copper, 0.2%; zinc, 1.4%; iron, 4.5%; lime, 1%.

Certain persistent habits of mineralization have been observed. The ore occurs along the vein in exceedingly irregular patches, or 'pockets'; these are irregular as to size, shape, position, and quality of ore. However, distinct shoots may be recognized with barren areas between them. These ore-shoots persist through the breccias into the felsites below, apparently with no change due to change of country-rock. The quartz filling is continuous in the fissure independent of sulphides. The dike also has no apparent influence on the mineralization. At the crossing of dike and vein there is no ore whatever, only fragments of dike and country-rock enclosed in clean quartz. At the point of tangential contact of dike and vein, the dike is again shattered, but, being along one of the recognized ore-shoots, there are sulphides with the quartz-enclosing fragments of rock. There is no ore in the cross-cuts reaching the dike, on either side. The vein cuts across the cross-slips at a constant angle of about 26° and in the areas of ore-shoots the ore invariably extends away from the vein for a few feet along the cross-slip. In the barren stretches there is no ore on the cross-slips. The 'caliche', or clay-filling, seems to play an important rôle in the mineralization. Usually the limits of an ore-pocket are defined by caliche completely filling the open spaces in the vein-fissure. Beyond the ore and caliche there may be up to a foot of open space between the quartz lining on either side but not an ounce of silver to the ton. The mineralizing solutions or emanations seem to have been confined within certain channels by the filling of caliche. A diagrammatic sketch of the conditions would be as in Fig. 2. The caliche is derived from the feldspar of the wall-rock. The feldspar phenocrysts of the felsite-porphyry in the vicinity of the vein are so decomposed that they may be picked out of their molds with the point of a pin. Some of the caliche, however, is attrition gouge. The finding of caliche in mine-workings has always been taken as a sign of the proximity of rich ore.

The mine may be considered young, as measured by the extent of mining operations to date. Only two levels have been opened and not along the whole length of the vein, below the adit-level. Above there are four main levels, but the ore has not been stoped out altogether. The vein was reached near the north-western boundary by a cross-cut adit 1150 ft. long, continued by the main-level drift for 1250 ft. in a direction S. 42½° E. to survey-station 629, or the point where the vein crosses the dike; then in a S. 34½° E. direction to station 648, or the

point where the vein again encounters the dike and both touch tangentially, for a distance of 750 ft. Near this point a stringer branches out. Finally, from station 648 the main vein continues for 500 ft. more in a S. 54° E. direction to beyond station 654. From the cross-cut adit in the opposite, or north-west, direction there are further-

division there are three roughly defined ore-shoots: the first is between stations 610 and 615 and has yielded only second-class or mill ore, in small quantities; the second shoot, at the No. 1 interior shaft, has produced some first-class ore in stopes immediately below the adit-level and has not yet been mined out completely. It has not been

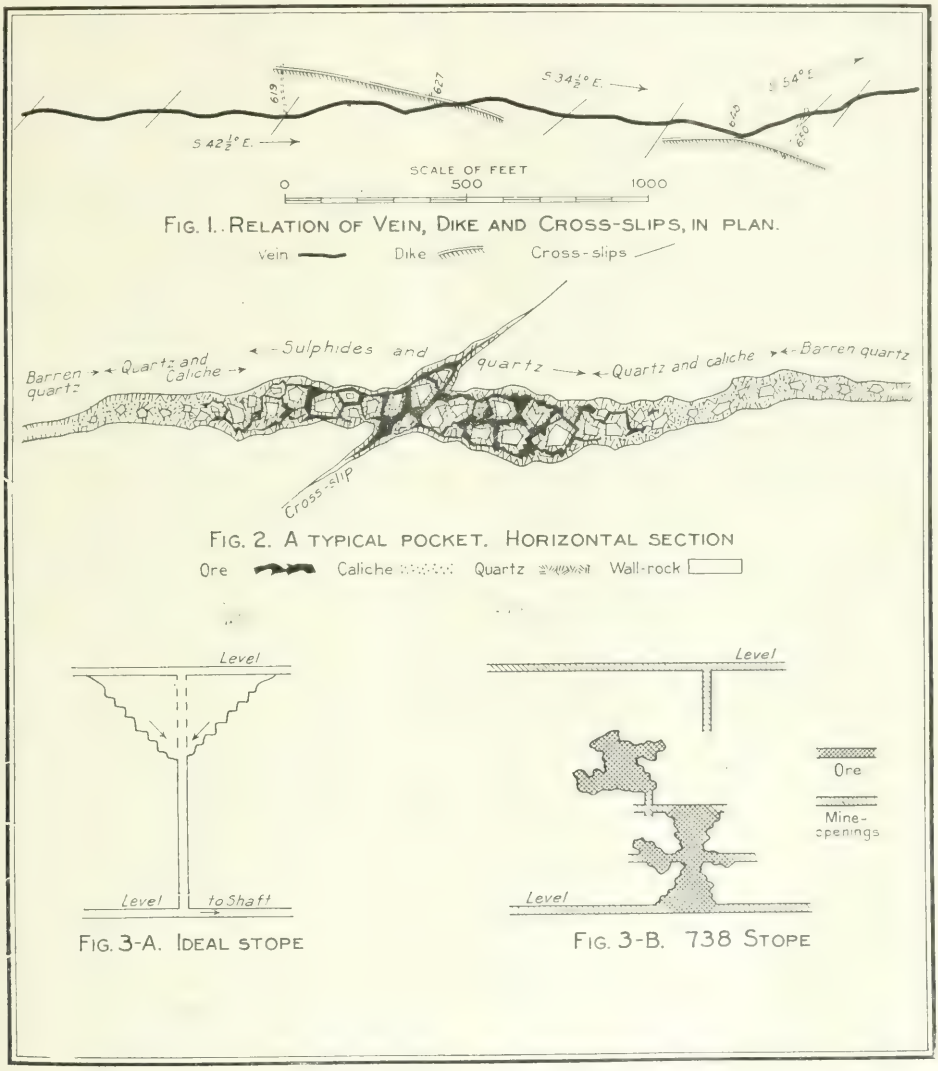


FIG. 1. RELATION OF VEIN, DIKE AND CROSS-SLIPS, IN PLAN.

FIG. 2. A TYPICAL POCKET. HORIZONTAL SECTION

FIG. 3-A. IDEAL STOPE

FIG. 3-B. 738 STOPE

more 520 ft. of drift. All these general directions between like points are the same on all levels above and below. There are thus four main divisions separated in a vertical plane by imaginary lines pitching 79° S. In the first division, north of the cross-cut adit there has been no ore found with the exception of a small and unimportant pocket cut by the Locarno shaft. In the second

found above the adit-level. The third and last shoot of the second division contains the discovery ore-pocket, which extends irregularly for about 150 ft. along the strike and which from near the surface to the 400-ft. level yielded several million ounces of silver. This is in the region of Las Chispas shaft. From the 400 to the 600-ft. level there is a break in the shoot, there being

practically no ore, but below the 600-ft. level the No. 2 shaft shoot appears to be the continuation of the Chispas shoot. The stopes reached from No. 2 shaft have yielded well and are not yet worked out, but the shaft has had to be abandoned and the ore will have to be reached from No. 1 shaft. The third division includes the most important part of the mine; within this there are two subshoots: the 38-39 shoot and the 43 shoot continue to the 800-ft. or deepest present level with no sign of discontinuity below 800 ft. as far as is ascertainable. No. 3 interior shaft is in the region of 43 shoot. The fourth and last main division contains the Tajo Chico called the 53 shoot below the main level and practically continuous with the 56 shoot, and, finally, the rather small pocket, but one that yielded very rich ore, where No. 4 interior shaft was started from the main level. No continuation of this ore has been found in the level above nor in that below. The Central air-shaft is close to the Tajo Chico shoot and in this region on the old levels above there is known to be considerable ore. These levels may be recovered by re-timbering.

At present no work is being done except in the 38-39, the 43, and the 53-56 shoots in the 700 and 800-ft. levels. For the past eight months production has been well above normal and absolutely all the ore extracted has been from the felsite zone below the upper breccia. The richest ore is in 842A raise from the 800-ft. level on the 43 shoot. On the 800-ft. level itself ore has been developed for 135 ft. in the north drift from No. 3 shaft and the end of the shoot has not yet been reached. This length of drift in ore on the 800 compares well with the longest drifts in ore in the breccia zone of the upper levels, thus exploding the theory that there are no important orebodies below the breccia zone. On the 800 the vein averages 6½ ft. in width and the ore from the north drift, after hand-sorting, has averaged as follows: first class, 20% of the total, 360 oz. silver; second class, 35% of the total, 55 oz.; and waste, 45%, with less than 3 oz. silver. The gold content is about ¾ of 1% of the silver. No stoping has been started from the 800 yet, but three raises have been just begun; one of which will connect with the 738 winze for ventilation. The three are in ore.

Mining methods will be described briefly: The wall-rock is firm throughout the mine and the vein nearly vertical. It is apparent that the best way of stoping would be to open a raise from one level to the next, and to underhand inclined slices into the raise, leaving open space above (see Fig. 3). This method would be splendid but for the fact that if the ore-patch is of the form shown in Fig. 3 (an actual stope), the preparation of openings through waste for the underhand-slicing method would cost considerably more than overhand-stoping on stulls, following the ore. One cannot know beforehand what the shape of the ore-pocket is going to be. Both underhand and overhand stoping are used as may be advisable, but in either case it has been found cheaper to extract all the waste instead of leaving it in the stopes on the necessary timbering. Timber is scarce, expensive, and of poor quality. Imported timber is not to be considered on account of the cost. Openings between levels are started from both ends simultaneously, connection of raise and winze being made at about half-way. Many intermediate short drifts as well as intermediate blind raises, inclines, etc., are made for prospecting along signs of ore and to find the continuation of a known patch of ore. Almost no timbering is required except for shafts, chutes, and the stulls in raises and overhand stopes, necessary for convenience, but not to sustain the walls. All ore is trammed out through the adit-level. Four interior shafts serve this level, but at present only one, the No. 3, is working. Each car, after being filled, is marked with the number of the chute or face it comes from, in order to keep a record of the production of each pocket of ore. This record has proved serviceable in prospecting for new pockets and more dependable than hand-sampling of the faces and stopes. The kind and grade of ore demand quality rather than quantity of material extracted, and mining operations are devised accordingly. The present compressor plant suffices for only six machines, besides the interior hoist and the one pump in No. 3 shaft, and the small column-hoist for winzes. Hand-drilling is employed to supplement the machines. Driving, sinking, and raising are generally paid by the foot of advance; stoping by the day, with a premium for an extra footage of holes drilled.

This article will end with a few remarks on recent local history: Political disturbances have greatly handicapped operations since 1911, by interrupting transportation and withdrawing security against labor troubles. In 1917 the mine was confiscated by the local government and handed back when all the rich ore exposed had been extracted. This confiscation followed a strike and favored the strikers, who obtained all their demands, while the mine was not operated by the company. Since then, however, better guarantee has been obtained from the Government. One result of the confiscation was the necessity for considerable unprofitable development work in the years following. Moreover, a flood swept away the pump-station on the Sonora river, leaving the mill without water. The pump-line has not yet been repaired and rain and mine-water have been used in the mill. Rain-water is available in limited quantities during the summer. The mine makes enough water in three months to fill the reservoirs for a mill-run of 10 days. The mill has had five 10-day runs each year in the past two years, producing about 35 tons of concentrate of about 500-oz. grade per run; head, 45 oz.; concentration, 11:1. The tailing is being saved for re-treatment. From the above it will be clear that at present the business of the mine is to produce first-class ore. The small amount of mill-ore extracted is in connection with shipping ore, the rest being left in place.

Safety, sanitation, lighting, and ventilation underground should receive proper attention and supervision. Safety devices and proper directed safety supervision more than pay their cost in decreased loss of labor through lessened accidents and saving in compensation. At large mines a safety-engineer is as much a necessity as a mining engineer according to the Bureau of Mines.

Three Hours With the Democrats

By C. T. H.

The Convention was a wonderful thing for San Franciscans. For the first time in history, this great event, the selection of a candidate for the highest office in the land by one of the great political parties, has taken place west of the Rockies. We who, perforce, have had to behold similar events through the eyes of Samuel Blythe, or Irvin Cobb, have had an opportunity to get our impressions first hand. Accordingly, on the second day of this history-making event, we hied ourselves to San Francisco's Auditorium prepared to behold with awe the portentous deliberations, to listen with rapt attention to the greatest spellbinders from 48 States, and to follow the words of the keynoter as he "views with alarm", and "points with pride".

After passing successfully the phalanx of police officers, ticket-takers, sergeants-at-arms, and other lesser dignitaries, we were conducted to a seat in the gallery, where we settled ourselves as well as possible on our aerie perch, and looked around at the rapidly augmenting throng. There was a glittering colorful panorama spread before us. On the main floor were the special seats for the delegates, each State section duly marked with its name on a placard erected on a stand. The ladies with their gaily colored hats and gowns added a pleasing touch of brightness. At one end of the great hall was the semicircular platform where the elect of the elect were seated. A husky table in front was provided to sustain the whacks of the chairman's gavel, while a magnavox sound-amplifier suspended from the roof and connected with the speakers' rostrum looked for all the world like a set of covered launders in a cyanide plant distributing pulp to a battery of Dorr thickeners from a central point.

Back of the platform and just below the great pipe-organ was an oil portrait draped in flags purporting to represent the President; at least we cannot imagine who else it could have been. Whoever the artist was, he certainly took atrocious liberties with the physiognomy of the man who is trying to make the world safe for Democrats for another four years. There he was looking down upon his satellites with an expression at once sardonic and admonitory, his watchful eye upon all they do, assisted by a glittering array of cabinet ministers, and other Federal office-holders in the flesh, who, as they flutter to and fro upon the floor, occasionally glance toward the portrait of their titular over-lord, as if in search of commendation and encouragement.

To the left of the organ in the gallery was what is known as an augmented brass band; and it was some band. Its working pressure must have been 100 pounds or more, with the safety-valve in imminent danger of popping most of the time. It could play 'Dixie' and, perhaps, one or two other things as alternatives during off periods. Then there was a mixed quartette, fully equipped with seven-passenger megaphones, through which the members shouted a medley of sounds, which were occasionally distinguishable above the band, the pipe-organ, and the cheering delegates. Below the platform, groaning beneath its weight of notables, were the press headquarters at which all sorts of special correspondents were busily grinding out the story of the convention by rounds for the edification of one hundred million free American citizens. Flags, and quantities of red, white, and blue bunting festooned the galleries, flanked by what might be called the 'house' banners of rival candidates.

It was 12:45 p.m. and the hour set for the beginning of hostilities was 1. Suddenly there was a commotion at the far end of the hall. Thousands of necks craned forward to see. "It is Bryan", said someone in an awesome whisper. The band played 'Dixie' and everybody yelled. It wasn't Bryan after all. It was just somebody or other with a bald head. The crowd sighed with disappointment and resumed their seats. A diversion was created by a quartette, this time unmixed, that essayed to shout a song about Palmer, the "peepul's choice", to the tune of 'John Brown's Body'. A rival quartette struck up something about Cox and his supreme qualifications for the presidency, and nearly drowned out the Palmer quartette until the band played 'Dixie', everybody yelled, and all were smothered. To show that they were not down-hearted, the Cox people, bearing banners proclaiming they were Cox's army, stamped around the aisles yelling themselves hoarse, accompanied by boos and catcalls from the camps of rival candidates. A shrill crowing that sounded like McAdoodle-doo showed political bias in favor of the present dynasty on the part of a sizable group of lusty-lunged patriots. Oh, yes, the band played 'Dixie', and everybody yelled.

Finally, at 2, a tall, imposing, bald-headed man approached the rostrum, and whacked the husky table with his gavel. He said something or other about the meeting coming to order, but it took a lot of whacks before the roar subsided, and the delegates and spectators quit shuffling their feet, and the band played, not 'Dixie', but the National Anthem. Then came the invocation by a bishop of one of the assorted churches selected for the task. He prayed long and earnestly, for the United States of America, the President, his official family, the Justices of the Supreme Court, Senators, and Congressmen, in fact for everybody except Republicans. He expressed the hope that those in authority would administer their trust with skill and foresight, in which prayer everybody joined. At times when his vocal efforts coordinated perfectly with the magnavox, an effect was produced that was reminiscent of the renaissance of the

phonograph; in fact one could almost hear that nasal "Columbia-a-a Rec-ord", with which the first of the disc records were wont to conclude their offerings.

Another whack from the Chairman's gavel, and he read a telegram to be dispatched to the Governor of Tennessee commending him for calling a special session of the legislature to ratify the suffrage amendment. He asked a unanimous vote for authority to send the telegram in the name of the convention. He put the question, and got a bunch of ayes and a considerable sprinkling of noes. "Unanimously carried", he blandly announced. The steam-roller was on the job. Then came the report of the Credentials Committee. This promised to be interesting on account of the fight over the seating of Senator Reed of Missouri, who, though a Democrat, has been bucking the administration program at Washington. The secretary of the committee took his place on the rostrum, and read his report. He turned down Senator Reed cold. A spokesman from the Missouri section asked the privilege of the floor, and proceeded to the rostrum. He mildly objected to the action of the committee as over-riding the action of the voters in Senator Reed's district, especially as that district was almost 'chemically pure' Democrat, and rolled up whooping big majorities for the Party. The secretary, in reply, displayed a little more vigor, and after calling Senator Reed a renegade Democrat, and stating that he wasn't elected by anybody at all, and that he couldn't have no seat, nohow, he sat down, well satisfied. Another whack of the gavel, and the Chairman asked for the approval of the committee's report. Again came a lot of vociferous ayes, followed by some vigorous noes. "Unanimously carried", quoth the Chairman. The steam-roller was shooting on all six.

Then came the *pièce de resistance*. With solemn voice the Chairman delegated three notables to escort the permanent chairman to the platform. Three spotlights burst into view and focused their blinding rays upon the three escorters, as they wound their way around to where the great man sat, and trotted after him to the platform. He was Senator Robinson of Arkansas. With the assistance of the committee of three, he popped up through the trap door and landed safely on the platform. The Chairman whacked some more and introduced the permanent gavel-wielder. He was greeted with prolonged cheering, and the band played 'Dixie'. Then, when the noise subsided, he stepped up to the rostrum, and began his keynoting.

He singled out the Republican platform as the object of his scathing denunciation. He ripped it up. He tore it to pieces. He took it apart, plank by plank, and reduced it to kindling wood amid the howls of his delighted audience, who viewed the destruction of that cherished structure with vociferous glee. He lambasted the Republicans. He called them names. He heaped upon them vitriolic vituperation. What a bully time he had, and how they all enjoyed it. "Why", said he, in effect, "have the Republicans failed to observe their time-honored custom of declaring that a Democratic administration is always synonymous with hard times. Because", he paused with fine dramatic effect, "the American people are enjoying a period of prosperity unparalleled in the history of our country". "Gee", remarked a bystander, *sotto voce*, "I didn't know the Kaiser was a democrat and started the War to drive all the business to this country. Anyway," he philosophized, "if the Democrats are responsible for $40 suits of clothes at $100, and $6 shoes at $20, I'll be doggone if I don't vote for Harding." He got up and went out. So did we.

James M. Cox

The career of Governor James M. Cox, Democratic presidential nominee, began on a farm. He worked his way to be editorial writer for the Cincinnati 'Enquirer'; owner of the Dayton 'Daily News' and the Springfield 'Press-Republican', when he formed the News League of Ohio; and thence to politics, being a member of the Sixty-first and Sixty-second Congresses, and eventually becoming, in 1913, Governor of Ohio, which office he now holds. Cox was born on a farm near Jacksonburg, Butler county, Ohio, on March 31, 1870, the son of Gilbert and Eliza A. Cox. As a boy he learned to know what chores were early in the morning and late at night. As soon as he was able he spent more time at work than at play.

Cox as a boy attended country schools and later was graduated from the Middletown high-school. He always was earning money of his own by doing odd jobs. He was once a janitor in a rural church. Later he was a newsboy, working up to a printer on a Middletown weekly, doing these things to help finance his way through school. He never attended college. After his graduation from school, Cox taught in rural schools for several years, but having a liking for the newspaper business he became a reporter on the Middletown 'News-Signal', then still owned by John Q. Baker, his brother-in-law, remaining there until he obtained a place on the Cincinnati 'Enquirer'.

Cox purchased the 'Daily News' at Dayton in 1898. The paper was at that time operating on a losing basis. However, he finally succeeded in making it yield a profit. Five years later he bought the Springfield 'Press-Republican', and today both newspapers are highly profitable institutions. He was elected to Congress in 1908 and re-elected in 1910. In this capacity he attracted the attention of State Democratic leaders, and in 1912, at the last nominating convention held in Ohio, became the party's candidate for Governor and won. His election in 1918 made him the only Democrat elected Governor three times in the normally Republican State of Ohio.

Governor Cox is a lover of the out-of-doors, plays golf, hunts and fishes, rides horseback, takes long hikes. He is stockily built, with a strong neck, indicative of combativeness, and has remarkable physical endurance. He is an eloquent campaign and after-dinner orator.

The Governor lives, when not at the executive home in Columbus, in a beautiful country home at Trail's End, near Dayton.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

COPPER QUEEN FINDS WATER FOR NEW CONCENTRATOR.

BISBEE.—During the past year development has been conducted by the Copper Queen branch of the Phelps Dodge Corporation in the Cochise shaft in Warren, to get a substantial water supply for the new 4000-ton concentrator which is under construction. Within the last few days a strong flow of water has been met on the 1700-ft. level, about 400 ft. south-east of the shaft in the Black Rock section. So far the volume has not as yet been gauged, but it is believed that it will be more than sufficient for the needs of the mill. A conference of branch managers, assistant managers, and other officials of the Phelps Dodge Corporation was held at Bisbee. Conferences of a similar nature are called periodically by P. G. Beckett, general manager for the corporation, for the exchange of views and the discussion of matters of general interest. Among those who will be present are the managers and assistant managers of the Bisbee, Morenci, Tyrone, Nacozari, and Globe branches of the corporation; the superintendent of the Copper Queen reduction works, the general auditor, and all consulting engineers.

The Wolverine Mining Co. is planning a prospecting campaign in the neighborhood of old abandoned workings. It is believed that good ore will be developed in the vicinity of the old works, and for the present mining operations in the new workings will be discontinued, and all efforts concentrated on opening up and re-timbering old drifts and stopes. Development work in the Nighthawk is progressing satisfactorily and it is expected that the main cross-cut on the 750-ft., or new, level should cut the ore with about 70 ft. more of work. It is stated that the orebody has been cut 30 ft. in one direction and 35 ft. in the other, with the faces of the drifts still in ore.

MILL AND MINE-SHAFTS OF THE MIAMI COPPER CO., ARIZONA

Drifting is also in progress toward the Boras side-lines with 350 ft. still to go before reaching the fracture between the Boras and Nighthawk. It is believed that the Boras orebody extends to this fracture and therefore the prospects for opening good ore at this point are quite promising. A good body of ore was recently developed on the 600-ft. level. Ore is at present being shipped from the 500, 600, and 650-ft. levels. Mining operations are being conducted on a conservative basis to the end that future mining may be conducted as efficiently and profitably as possible.

JEROME.—Claud Ferguson of the Consolidated Arizona Smelting Co. is now in charge of the Planet mine. He is opening the old workings and finding favorable orebodies, preparatory to shipping ore to the smelter. It is rumored

that the California Southern railroad will join the Arizona Swansea and will then extend the latter railroad from Swansea around to the Planet mine. Several engineers have already been over the route, but no information is as yet obtainable as to when construction work will commence.

The Swansea mine is operating with two shifts at work in the mine and one shift running the mill, where it is stated a saving of 99% is being made. Eleven teams participated in the machine-drilling contest held at Jerome on the Fourth of July; four from the United Verde, four from the Extension, two from the Jerome Verde, and one from the Jerome Superior. There were six entries for the hand-drilling competition with double-jacks.

COLORADO

SHORTAGE OF LABOR IN CRIPPLE CREEK.

LEADVILLE.—Lead-silver ore assaying 38% lead and from 10 to 20 oz. silver has been opened up on the Chrysolite lease in a drift extended into virgin ground. The vein has been followed for 100 ft. and shows no sign of discontinuance. Two cars, about 60 tons, of zinc-silver ore were consigned to the A. V. smelter last week by Harry Schrader of Lake county, operating the Griffin property in the St. Kelvin district. The ore has an estimated value of $30 per ton, and was mined from a vein averaging more than two feet wide that was recently opened in new territory.

High-grade ore averaging $100 per ton is coming from rich streaks in a fissure vein under development in the Dinero tunnel in the Sugar Loaf district. Second-grade ore shipped to the A. V. Smelter brought $40 per ton. Water is interfering with leasing operations on the Fanny Rawlins, and in excess of 100 tons of ore already broken will be delayed in shipment on that account. The ore contains gold, silver, and copper. Machinery has been installed and the shaft on the O'Donovan Rossa has been re-timbered and made safe to a depth of 523 ft. The old caved drift at this level has been opened for 200 ft., where work will now be started in expectation of opening an orebody dipping into the mine from adjacent workings.

GEORGETOWN.—Many old properties in the Georgetown-Empire district are resuming and, while production is at present light, development undertaken should bring more ore to the mills. The Seven Metals company is overhauling machinery at the Wilcox tunnel at Argentine, and work will be resumed after the holidays. H. M. Vincent has resumed on the East Argentine group owned by him and will shortly be shipping from a shoot of silver ore opened up before the property closed for the winter. Work is also to be resumed after the holidays in the Raymond tunnel, impending litigation having been satisfactorily settled. The Boston group in the Empire district is again active and development has been resumed by lessees. The Empress tunnel at North Empire is being re-timbered and placed in condition for development by the Randolph Gold Mining Company.

ASPEN.—An examination has recently been made of the properties of the Contact Mining Co. and Midnight Mining Co. in Queen's Gulch and Richmond hill and of the Fred Anderson group, in the Lake district of the Taylor river section, by mining engineers representing Eastern interests. The Fred Anderson group, if the report is favorable, will be purchased by the Cotoba company, controlled by Kansas City interests, and the Contact-Midnight properties by Pennsylvania investors. Construction of a mill is planned by the Hunter Park Mining, Milling & Leasing Co., and with a plant in operation large bodies of low-grade ore under development will be milled at the mine. The Little Annie mill of the Richmond Hill M. & M. Co. is to be increased to 50 tons capacity. Ore is broken in the mine and awaits alterations to the plant.

CRIPPLE CREEK.—Exploration on the 9th and 10th levels of the Rose Nicol mine adjoining the Portland estate on Battle mountain is being done by the Reva Gold Mining Co. that holds a long-time lease on the property. A drift and cross-cut is being carried on each level and, while the material in the drifts is low-grade, John Nicholls, the superintendent, expresses confidence in results. The diamond-drilling in the north-east end of the district is reported progressing, but beyond the fact that the drill is gaining depth no information of interest has been made public.

Sheriff Von Phul has leased the Jefferson mine dump on Gold hill. The mine, once a heavy producer of rich ore, has long been idle and the dump has never been worked over. Labor is scarcer than at any previous time in the district and, due to the cutting-off of the electric-car service, difficulty is experienced by miners in getting to work.

MICHIGAN

SHORTAGE OF COAL STILL THREATENS.

HOUGHTON.—Shortage of coal continues to dominate the mining situation. Bluntly stated, the Michigan copper mines have not coal enough to supply them for more than two months. That is the outside forecast. Quincy, the third largest of the Lake producers, has been operating on borrowed coal for a month. On June 23 it announced that it had a cargo afloat, but that it would have to pay back the greater portion of it to the Calumet & Hecla, so even this cargo does not help Quincy. Copper Range announces that it has coal on the way, a cargo being loaded on June 23 at a Lake Erie port. Without this it is doubtful if the Champion, Baltic, and Trimountain mines and the Copper Range railroad could continue to operate. Some of the smaller mines, notably Seneca, Mayflower, and Arcadian Consolidated, have supplies for two to three months.

Metal shipments from the Lake district have been almost negligible. Less than 1000 tons has been shipped in a fortnight by water. Calumet & Hecla is making rail shipments for foreign account. The company sold last week about 500,000 lb. to a European customer. It obtained fast delivery to seaboard on the Canadian Pacific.

A recent French order, said to have been 75,000 tons of copper, was not participated in to any great extent by Michigan mines. In fact foreign orders will not be a factor in this district till Germany begins buying. Germany formerly took as much as 36,000,000 lb. of Lake copper per month.

Committees are making preliminary arrangements for the entertainment of the American Institute of Mining and Metallurgical Engineers, which meets in the Lake Superior district in August. John Knox, underground-superintendent for the Calumet & Hecla, is chairman of the Copper Country committee, and with him is associated the alumni association of the Michigan College of Mines. Tentatively the program includes trips by automobile to the principal plants of the district, sessions at the College of Mines in Houghton, and social entertainment at the clubs and the college. The party comes to Houghton by boat and leaves by rail for the Michigan and Minnesota iron-districts.

Mining news centres around the small mines and prospects. The bigger companies are doing nothing in the way of construction or exploration, with the exception of the Calumet & Hecla's re-grinding plant for Tamarack sands, and the Quincy's new hoist at No. 2. The Stanton mines have abandoned temporarily large plans for metallurgical operations. Mayflower continues extensive exploratory and development operations with favorable indications appearing in each of the three directions, north, south, and west. White Pine is now employing 150 men and is producing 450 tons per day. This mine is badly handicapped by lack of labor. It could double its force in its present openings. While Michigan showed a production increase in May, as compared with April, it is badly hampered by labor shortage. Its drifts in the Butler lode cannot do justice to themselves with the present working force, which is half below normal. Victoria, free from coal worry, with its hydraulic-compressor plant to furnish power for all operations, cannot do itself justice because of its small force. It is the most isolated mine in the district and does not attract new men. Mass copper is helping materially in keeping up the Victoria yield. Seneca continues as a producer from its original Seneca shaft and at the Gratiot shaft has definitely identified the Kearsarge lode. For this reason Gratiot development is being pushed.

THE BUTTE & SUPERIOR MINE

MONTANA

NORTH BUTTE COMPANY IS CROSS-CUTTING ON THE 3600-FT. LEVEL.

BASIN.—The Ruby group of claims, which is now being worked by lessees, is to be developed by driving a cross-cut tunnel from the mill for a distance of 2500 ft. This will serve to tap the vein known to exist at the 800-ft. level. Plans also include modernizing and enlarging the 10-stamp mill now on the property.

ELLISTON.—The Silver Pick Mining Co. has resumed

further sinking operations on the Julia claim from the 350 to the 400-ft. level. The present owners have installed complete up-to-date equipment, which shoul prove adequate for several years active work. Smelter assays show 63 oz. silver, 4½% copper, $11 gold, and 10% lead. Charles Riley is in charge of operations, on which 16 men are being employed.

BUTTE.—The North Butte Mining Co. reports satisfactory development on the 3200 and 3400-ft. levels of the Speculator mine. The orebody on these levels shows no diminution either in size or in copper content. On the 3400-ft. level this orebody averages more than 4% copper. Cross-cutting is now being undertaken on the 3600-ft. level in the direction of the orebody. The production costs continue to hover around 14c. per pound.

CLARK'S FORK.—A 16-in. vein of bornite has been uncovered on the Clagy-Verdun property at a vertical depth of 30 ft. Work on the property was started only recently. Owners of the Mike Horse mines, on the North Fork of the Blackfoot river, report that satisfactory development work is in progress. No. 3 tunnel is now 800 ft. long. One vein of milling ore has been cut by this tunnel. No. 1 tunnel exposed a 6-ft. vein of good ore. In No. 2 orebodies from 6 to 12 ft. wide have been exposed in three stopes. Archie McDonald is resident manager.

NEVADA

BULLION SHIPMENTS FROM TONOPAH.

GOLDFIELD.—The north drift from the west cross-cut on the seventh level of the Florence is 220 ft. long and that to the south is 170 ft. long. These drifts, 726 ft. from the shaft, are in a vein 20 to 25 ft. wide. They have been driven on the foot-wall and two raises have been driven short distances from them. Two cross-cuts have been started to the hanging wall and it is planned to sink a winze. The vein is a promising body of quartz and E. A. Byler, engineer for the company, says the possibilities have not been exhausted and that work will continue until at least one winze has been sunk. There are several other wide veins in the west cross-cut and if the work being done fails to open ore, as appears probable, these will be prospected. A short branch from the south-east cross-cut has connected with the Aurelia lease-shaft after a fight with caving ground that lasted two months. This connection is for air and the shaft is being cleared. The cross-cut is being continued from where the branch was started. The objective, a point under an outcrop, thought to mark the southern extension of the Jumbo vein, is 300 ft. distant. A small quantity of ore has been sent to the Development mill from the Cracker Jack lease, but an important shipment has not been made from the Florence since April. The Florence management has two objects in the present work: to prospect veins west of the shaft and parallel to the main ore-channel, and to search for the main ore-channel south-east of the shaft. Maps show this ore-channel to extend through the Consolidated and Florence at a constant distance from the supposed Columbia Mountain fault, which in the southern part of the Florence has been thought to turn east into the C. O. D. The strike of the outcrop, that is the objective of the south-east cross-cut, indicates a possibility that after turning east the fault again extends south. This fault was not recognized in the west cross-cut, but it is supposed to exist from the depth at which the latite is found east and west of it. Some engineers say this fault, which has been discussed for many years, does not exist. J. K. Turner, a Goldfield mining engineer, W. J. Tobin of Pioneer, and others are preparing to start work on patented claims owned by them near the Five to One tunnel. The tunnel, over 125 ft. long, is being advanced three feet daily. From the 125-ft. point it is lined with 6 by 8-in. timbers and 3 by 8-in. lagging. The present depth is 235 ft. and in 75 ft. more the greatest depth, over 300 ft., will be reached under the peak of the hill. The tunnel will be continued through the hill to determine if there is a vein. Rich pannings are secured and the work has attracted attention because success would mean the opening of ore more than two miles south of the Florence. Negotiations between the Consolidated and Jupiter companies indicate that the former is to build a plant and retreat the mill tailing. The Jupiter owns one-third of the ground covered by the tailing, which is in places 16 ft. thick. It was reported several years ago that the tailing had an average value of $4.10 per ton, but re-treatment in the mill, to which it was raised by a tramway that was costly to operate, did not give good results.

TONOPAH.—Ore 7 ft. wide and assaying $40 to $50 per ton has been opened by the Tonopah Extension in the Murray vein at a depth of 1760 ft., according to unofficial reports. The first mill clean-up in June was valued at $49,000. The first clean-up of the Belmont mill in June gave 76,000 oz. of bullion worth $83,600. The gross production during the first quarter was $419,000. The operating expense was $318,450. The Surf Inlet in British Columbia, a subsidiary, gave a profit of $100,000.

DIVIDE.—Sinking of the Tonopah Divide shaft from the 800-ft. level has been started and will continue at a rate of three feet per day until the water-level is reached. This work, as usual, is being done with an auxiliary hoist.

BATTLE MOUNTAIN.—A carload of 100-oz. silver ore is being hauled from the Kattenhorn at Maysville for shipment. A number of lessees started work in the Kattenhorn last summer and since then irregular shipments of rich silver ore have been made. The mine contains many narrow shoots of high-grade ore, ideal for development by lessees. It was at one time under option to George Wingfield.

ARROWHEAD.—High-grade silver ore continues to be found in the Arrowhead shaft, now 270 ft. deep. Drifts will be driven at this depth. Ore 12 in. wide and assaying 200 oz. is exposed. A heavy flow indicates that the permanent water-level has been reached. The west drifts on the 100-ft. level and the intermediate level below continue to show 4-in. to 1-ft. widths of rich silver-gold ore, with 3 to 4 ft. of low-grade material.

MANHATTAN.—The ore on the 800-ft. level of the White Caps can be treated successfully by a process of flotation,

roasting, and cyanidation, according to the result of tests made for several months. The work on the 800-ft. level has been done east of the shaft and after the ore to the west and above the level has been tested it is planned to add a flotation plant to the present equipment.

UTAH

MINE-RESCUE AND FIRST-AID TEAMS ARE TRAINING FOR CONTEST IN DENVER.

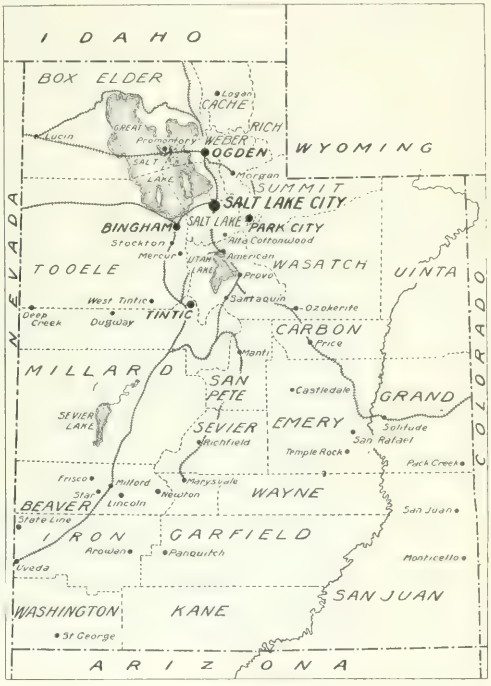
Salt Lake City.—Eight teams from Utah are expected to compete for the international championship in the first-aid and mine-rescue contest, to be held at Denver on September 9, 10, and 11, according to Dr. Arthur L. Murray, surgeon in charge of mine-rescue car No. 11, stationed in this city. Several years ago, a team from the Utah Fuel Co. won the world's first prize at San Francisco. The car of which Dr. Murray is in charge will be at the disposal of any crews wishing to train for the championship match during the entire month of August. The teams, which compete at Denver, will be made up of five men and a captain. Not more than one first-aid and one mine-rescue team may enter from any one mine, smelter, or mill; members of all teams must be bona fide employees. There is no limitation as to the number of teams which may enter from any State or district. The same team may enter for both mine-rescue and first-aid work. It is expected that teams from Park City, Eureka, Bingham, and from the coal mines in Carbon county will attend the contest.

Assessment of the metalliferous mines in the State, for taxation purposes, on the basis of three times the net proceeds, fell off $29,295,402 in 1919 as compared with 1918, according to figures compiled by the State Board of Equalization, or a decrease of practically 50%. The assessed valuation of every other class of property in the State was increased, with the exception of water companies, but the increases were not sufficient to offset the reduction in revenue from the metalliferous mines. The real estate of metal mines, with the exception of ground owned for mills or townsite purposes, is assessed at a flat rate of $5 per acre. During 1918, mining real estate was assessed at $10,155,058, while during 1919 it was assessed at $13,596,864. Improvement and machinery at the mines of the State was assessed at $23,061,317 for 1919, as against $22,877,982 for 1918.

Boxelder County.—At the property of the Vipont Silver Mining Co., near the Utah-Idaho line, 90 men are now employed and shipments of silver concentrate are being hauled by truck to Oakley, Idaho, 25 miles distant. East of the Vipont properties, Tony Scoro and others are driving a tunnel, while to the west the Utah-Idaho Mining Co. is driving a cross-cut in the hope of reaching the same orebodies. At Rosette, it is reported that the Old Century and Suzanne properties will resume operations. At the property of the Salt Lake Copper Co. three lessees are now working. Seventeen miles north-east of Wendover, three small properties are operating at the south end of the Silver Island mountains.

Alta.—Operations at the Cardiff property in Big Cottonwood canyon are being carried on at near capacity, and shipment of ore from the mine to the bins at South Fork has been started, the wagon-road now being in good condition. Fixe trucks are being used for ore-hauling, and a sixth kept in reserve. Forty men are now employed at the property, and this number will be increased.

At the annual meeting of the Big Cottonwood Coalition Mines Co., the following officers were elected for the ensuing year: W. G. Romney, president; E. J. Jeremy, vice-president; C. E. Robertson, secretary-treasurer; H. J. McKean, James A. Stanley, and W. H. Hurd, additional



MAP OF UTAH

directors. A new compressor was recently installed at the property. During the past year the company purchased a controlling interest in the Copper King Mining Co. Robert Gorlinski, mining engineer of Salt Lake City, has been engaged to make a complete survey of the company's claims for patent. During the past year the main adit was extended 926 ft., making the total length 2680 feet.

Park City.—Shipments of ore for the week ending June 26 totalled 2234 tons, as against 1309 tons for the previous week. This increase was due to the removal of the embargo at the Murray smelter, to which most of the local mines ship their ore. The Silver King Coalition resumed shipments with the lifting of the embargo; this company not being permitted to ship any ore the previous week. The Judge M. & S. Co. shipped 796 tons; the Ontario, 718 tons; Silver King Coalition, 502 tons; and the

Daly-West, 228 tons. The Judge smelter shipped 108 tons of premium spelter during the week.

Larry Murphy and Malachi Maloney, miners, were severely injured in an accident in the Alliance tunnel, and have been taken to Salt Lake City for surgical treatment. The men, who were doing repair work, were injured when an empty car, which had been set on a sidetrack for their use, was hit by swaying cars of ore on the main line and tipped over on them. Both men were injured internally, and also sustained fractured arms.

Eureka.—Charles Zabriskie, manager, states that two drifts are being driven at the property of the Lehi-Tintic company in the northern part of the district. Owing to shortage of power, there is but one shift being worked in each heading. The drift which is following the north-south break is reported to be in a promising formation. The other drift, which is being driven for the purpose of cutting the Gold Blossom vein, is passing through a hard formation, and no change is expected for the time being.

At the Copper Leaf property, in the eastern part of the district, but one drift, on the 1000-ft. level, is now being driven; work on the 1200-ft. level having been suspended for the time being. Officials of the company feel confident that as soon as the lime formation is reached the drift should enter more promising ground.

After sinking the Central Standard shaft to a depth of 490 ft., the work has been temporarily suspended in order that a reservoir may be cut on the 400-ft. level. This reservoir is needed to take care of water which was developed during the first 200 ft. of sinking; the reservoir which was cut in the porphyry formation not being satisfactory. John W. Taylor, manager, states that sinking of the shaft will be resumed shortly, and with the water properly taken care of, better headway will be made. The first 400 ft. was in porphyry formation, then about 40 ft. of shale was passed, while the last 50 ft. has been in decomposed lime, which carries iron.

Walter Fitch Jr., mine contractor of this district, has returned from Pennsylvania, where he has had an important contract in driving tunnels. Mr. Fitch brought with him a number of experienced tunneling men who will be employed in various pieces of work now under his direction in Utah and Nevada. Cecil Fitch, manager, states that a drift is advancing at a depth of 1750 ft. in the Plutus company's property. It is estimated that 200 ft. of drifting will be required to cut an important system of faulting, and officials of the company consider this the most promising piece of development that has been taken up in the Plutus ground. It is being done through the Chief Consolidated shaft. About a year ago, ore was encountered in the Plutus at a depth of 1000 ft., and since that time a winze has been sunk 750 ft., while considerable prospecting was also done on the 1400-ft. level.

BRITISH COLUMBIA

[illegible] REPORTS.

New Denver.—After [illegible] substantial body of zinc-blende and galena ore has been cut by a raise between No. 4 and No. 6 levels at the Bosun mine. This mine is being operated by the Surprise-Rosebery Mining Co., which owns also the Surprise mine, near Cody, and the Ivanhoe, near Sandon. The company has moved its offices to New Denver. Except for a few miners who are working on contract, the Standard mine, at Silverton, is being operated entirely by four groups of lessees, all of whom are doing well. Some unusually rich silver ore is being taken from the mine. Bodies of zinc-blende containing freibergite, granular chalcopyrite, and occasional films of ruby silver have been found closely associated with the lenses and dikes of porphyry, which have intruded into the zone between the vein walls. The lessees are in communication with several smelting companies with the object of trying to get more satisfactory treatment-terms for this class of high-grade silver ore. Considerable adverse feeling has been aroused locally against the Silversmith Mines, Ltd., for its capitulation to the 'One Big Union'. The general opinion is that the members of this organization, who have done nothing for the workers and have been a considerable source of annoyance to the mine-owners, should be run out of the camp. The other mines in the district, while running an 'open shop', favor the International Mine Workers Union. When the O. B. U. called a strike many miners left the camp, and now are working at other camps, some at less than the Slocan scale of wages.

Nelson.—The Granite Poorman mine has been taken under lease and bond from the Vincent Development Co., of Walla Walla, Washington, by a recently organized syndicate. The Vincent company has had the property under option for some time, but concentrated its energies at the Eureka mine, where it did considerable underground development. It constructed a tramway, too, from the Eureka to the Granite-Poorman mill, and reconstructed the mill and added a flotation plant. The new syndicate will reap the advantage of all this work.

Alice Arm.—The McLennan Silver Mines, Ltd., which recently acquired the Royal group, adjoining the Dolly Varden property on the west, has traced a vein for 400 ft. on the surface, which is believed to be an extension of the No. 4 Dolly Varden vein. The vein is 12 ft. wide, and samples taken from it have run up to 320 oz. silver per ton. A tunnel has been started on the vein, 600 ft. below the summit of the hog's back. A semi-Diesel compressor is being put in place at the North Star mine. The Dolly Varden is running at least one train per day and sometimes two. Each train carries about 90 tons of ore. The United Metals Co., Ltd., in the Alliance River district, has 20 pack-horses taking supplies into the mine and bringing ore to Alice Arm. Unless labor troubles break out afresh, there is every promise of a successful season in this district.

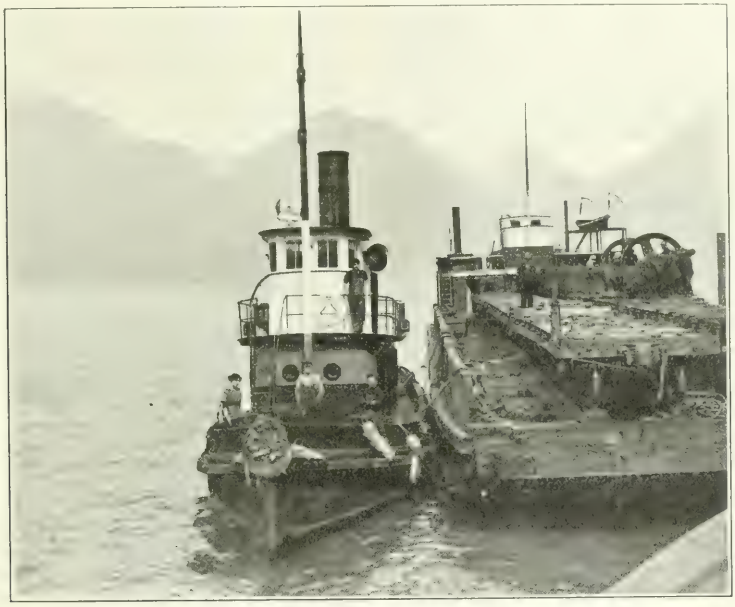
Hazelton.—The Kitselas Mountain Copper Co.'s concentrator at Usk has been in operation since early in June. It is giving satisfactory results. A considerable quantity of ore is being treated and development is in progress at the mine. The ore carries gold, silver, and copper.

The Silver Standard mine has been shipping steadily this year and important development also is in progress. A new tunnel is being driven which has reached two veins and will continue until it cross-cuts the main lode. Transportation to the concentrator is furnished by a large motor-truck. It is used both summer and winter. Traveling in the winter is good after the snow becomes hardened, wires being wound about the truck wheels to ensure traction. Considerable high-grade ore is being shipped direct to the Trail smelter. Although the property is very promising it is yet in the development stage.

BARKERVILLE.—Placer miners are preparing for the season's work in the Cariboo district. John D. Galloway, government mining engineer, recently made a trip through a part of the section and, while it is impossible as yet to estimate the extent of the hydraulic mining to be undertaken, the prospect is good. Owing to the unusually late spring and the heavy fall of snow there should be a plentiful supply of water and late-fall operations appear assured. The old channel on Grouse creek, where the gravel is reported to be good, will be piped by the Waverly, and there will be operations at Lowhee and Stout's gulch. Generally it is expected that most of the old companies will be on their ground again and that some new leases will be worked. Notwithstanding lack of labor and high costs it looks as though the old Cariboo would see more placer mining, both hydraulic and individual, than it has for some years and that the gold output will increase.

ROSSLAND.—The faith of the old-time residents of Rossland, one of the oldest mining towns of the Province, that prosperity, which momentarily passed when the mines of the Consolidated Mining & Smelting Co. were practically closed down, would return is about to be justified. The company's mines, it is stated, are to be put on a producing basis very soon, it being expected that shipments will be resumed early in July. The ore-bunkers have been repaired; ore from the Mandy mine, Manitoba, which the management likes to handle with the Rossland mineral, is being received. There is still some question as to labor. If the men are available there is no doubt that the mines will be operated without delay and that Rossland once more will be active.

TRAIL.—Ore-receipts at the Trail smelter of the Consolidated Mining & Smelting Co. for the week ending June 14 totaled 6913 tons. For the week ending June 21 there was received 6742 tons. Two new shippers appeared in the latter list, namely, the old Whitewater mine, of Slocan, and the Sunnyside, Rock creek. The total ore receipts at the smelter for the year up to date are 135,068 tons.



UNLOADING MACHINERY AT THE BRITANNIA WHARF, B. C.

PRINCETON.—W. P. Tierney, the contractor in charge of the construction of a railroad to connect the Copper Mountain mine of the Canada Copper Co. and the Kettle Valley railway, has stated that rails will be laid within 30 days. This 15-mile stretch of steel probably represents the hardest and roughest piece of construction undertaken in western Canada in recent years. The only work comparable to it is the road to the Dolly Varden mine. The contractor states that the cost totals $1,500,000. He describes it as having been heavy rockwork, bridges, and trestles all the way.

ONTARIO

SUPREME COURT HANDS DOWN DECISION IN UNION NATIONAL GAS SUIT.

TORONTO.—An important point in regard to the taxation by municipalities of oil and gas wells has been settled by a decision of the Supreme Court of Canada, in the case of the Union National Gas Co. v. the Township of Dover. The company appealed against the assessment by the Township of the income from two producing oil-gas wells at $62,376, being the amount of the returns for the year, less operating costs. The company claimed the right to deduct from the income, in addition to operating expenses, a deficit for the preceding year, and expenses for dry holes or unproductive wells, and rentals paid for oil and gas leases. The case was appealed from one tribunal to another, the original assessment being confirmed at every step, and the decision is again upheld by the Supreme Court of Canada, holding that the company could not make any deductions except for operating expenses.

KIRKLAND LAKE.—The Lake Shore produced $41,187 during May from the treatment of 1636 tons of ore with an average recovery of $25.18 per ton. Most of the ore now being milled comes from development work, but little being taken from the large orebodies blocked out. The management has decided to sink the shaft to the 800-ft. level At the Harvey Kirkland two more veins have been uncovered. Stripping is actively in progress. A survey party is at work on the line of the Canadian Light Railways Ltd., which will run from Swastika through the producing area of Kirkland Lake and the new properties in Lebel township to the Larder Lake district.

GOWGANDA.—Additional rich discoveries are reported on the Castle property of the Trethewey. The vein recently cut on the shore of the lake has been traced over the brow of the hill and close to the first shaft. A shaft is being sunk on it and at a depth of 20 ft. the vein is producing ore of excellent grade. A new vein has been found running directly under the office building. Four shipments in all have been made since operations were started and the company has a large supply of high-grade ore sacked ready for shipment.

BEAVER HOUSE LAKE.—The management of the Argonaut has decided to sink to a depth of 500 ft. A 12-drill compressor and high-speed electric hoist have been installed and plans for the construction of a large mill in the fall are being considered.

COBALT.—A decision has been handed down by the Supreme Court of Ontario in the dispute between the O'Brien and the La Rose companies, having to do with the correct location of the boundary between the O'Brien mine and the Violet property of the La Rose. The O'Brien is declared to be entitled to possession of all the territory lying west of a direct line running from No. 4 post of the Colonial mine to the Shaw, thence to the Earle property. The La Rose is enjoined from trespassing beyond that line and damages are awarded. Cyril W. Knight, assistant provincial geologist, has commenced the work of making a re-survey of the geology of the Cobalt silver area. It is estimated that the Bureau of Mines will have the field-work completed by late fall. Silver production from Cobalt during the first half of 1920 amounted to approximately $5,400,000, according to preliminary estimates. Cobalt metallics and cobalt oxides marketed as a by-product brought the total value up to about $5,750,000. The decline as compared with a year ago amounts to about $1,000,000.

The Victory Silver Mines has increased its capital from 500,000 shares of the par value of $1 each, to 2,000,000 shares of similar par value. Plans are being made to commence mining operations. The Nipissing Mining Co. will disburse a 5% dividend, amounting to $300,000, on July 20. Total dividends from the Nipissing during 1920 amount to $1,200,000, while the aggregate since 1906 amounts to $21,540,000. The company has 1,200,000 issued shares, distributed among 13,000 shareholders. Liquid assets, consisting of Canadian and United States war bonds, as well as cash, ore in transit, etc., amounts to slightly over $5,000,000. Production continues at the rate of well over $4,000,000 per year. A movement is under way with the object in view to induce the government of Ontario to set aside ten townships in Northern Ontario, the timber from which to be sold by tender and the proceeds to go toward the construction of a macadam road from North Bay to Cochrane, with branches to Porcupine and to Iroquois Falls, covering a total distance of about 300 miles at an estimated cost of $3,000,000. This would connect the mining, lumbering, and agricultural districts of Temiskaming with Southern Ontario.

YUKON TERRITORY

DREDGING OPERATIONS COMMENCE.

WHITE HORSE.—The North West Corporation has assembled its dredge on Claim 20, Dominion creek. The dredge was hauled from the upper Hunker river during the winter. The corporation has secured a second dredge which will be worked on lower Dominion creek, near Grenville. The Yukon Gold Co. has a dredge working on Gold Run and another on the lower Hunker. Three of the company's dredges are still idle. The White Pass boat 'Reliance' has loaded 800 tons of ore on the Kantishna river from the Tom Aitkin mine, for smelters in the South. The Yukon Silver Lead Mining Co. has shipped 30 tons of high-grade silver ore from Lookout Mountain, in the Mayo district. The Dominion government will erect a radio station at Mayo during this summer, so that the camp may not be so cut off during the long winters. The mail of June 1—the first in six weeks from the Mayo camp—brought 120 applications for mining claims from that district. The greatest prospecting activity was at Keno Hill and Lookout Mountain. Dr. Cockfield who is in charge of the Geological Survey field-work in this district, has arrived at White Horse. He is accompanied by T. F. Armstrong, W. G. Cuttle, C. A. Merritt, and A. E. Pattison. The party will outfit at Dawson and then take the field.

COURT GIVES MINER JUDGMENT FOR $500,000

The United States Circuit Court of Appeals has awarded John Tuppola possession of Alaskan mining claims valued at more than $500,000, property that heretofore had been claimed by the Chichagoff Mining Co. Tuppola, in 1914, became joint owner with the Chichagoff company of four valuable claims near Sitka. In order to gain complete possession, avers Tuppola, the mining company brought suit against him, charging insanity, had Tuppola tried and sentenced to an asylum. Later the claims were sold by a guardian for $1000. Subsequently Tuppola brought suit in the Alaska court and was defeated. His victory yesterday gives him possession of two claims and one-half interest in the claims held by the Chichagoff company. An accounting of all profits since 1914 also is ordered to be made to Tuppola.

ALASKA

Anchorage.—Good reports come from the Willow Creek district on the government railroad less than 50 miles from here. Willow Creek promises to become one of the heavy gold producers of the Territory.

Juneau.—The Alaska Treadwell Gold Mining Co. has taken a bond on twelve quartz claims on Nixon Fork on the Kuskokwim and is now busy prospecting the property. ——The Independent Mining Co. reports the discovery of a rich orebody six feet wide at the end of a 109-ft. tunnel on its property at Windham Bay.——A contract for driving a tunnel 1000 ft. long has been let by the Admiralty Alaska Mining Co. which is operating at Funter Bay.——The Alaska Endicott Mining & Milling Co. has resumed operations at William Henry Bay where water-power is being developed for a saw-mill preparatory to the erection of a stamp-mill.

A syndicate has been formed at Juneau for the purpose of developing the Red Top group of claims on Bear Creek in the Portland Canal district. All the larger quartz mines of Alaska are operating full crews, and pre-war production has been resumed by the Alaska Treadwell, Alaska Juneau, Alaska Gastineau, Chichagoff, Kennecott, and Latouche companies.

Nome.—Regardless of almost prohibitive transportation costs, increased and renewed activity in placer mining is reported and no less than twenty big outfits are operating within fifteen miles of here. Extensive prospecting for oil is also reported.

Valdez.—The Columbia Red Metal Co. has resumed operations at Columbia Glacier near Valdez and is employing 50 men. A railroad carries ore from the mine to where it is loaded on steamers for shipment to an outside smelter.—— The Valdez Gold Mining Co. has resumed operations and is assembling supplies and equipment necessary for driving a new tunnel.

ARIZONA

Jerome.—Smelter chemists have been taking samples of air around the reduction works at Clarkdale and Clemenceau for careful analysis of the foreign gases contained. This has followed an investigation by State bee experts, who have found a sickly condition prevalent among the bee colonies of the Verde valley, with the total loss of many hives. The bee owners claim the trouble lies entirely with the smelter fumes.——There is local belief that the great orebodies of the camp are pitching toward Mexico under the Don Luis section, where exploration is finding new orebodies at comparatively shallow depth, though there is no expectation of striking continuations of the Bisbee lenses short of 2000 ft. The Boras mine has developed into a strong shipper and the adjoining Nighthawk is shipping about twenty carloads per month of 6¾% ore from the 500, 600, and 650-ft. levels. A cross-cut now is being run on a new level at 750 feet.

Miami.—By cutting its dividend from $6 to $4 per annum the Inspiration Copper Co. has eliminated the necessity of drawing further from surplus. Present earnings cover dividends at the new rate of $1 quarterly. The reduction will save $2,363,934 in dividend outgo. Last year a deficit of $2,905,174 resulted after paying the full year's dividends. Under the existing curtailment policy Inspiration's production costs have remained relatively high, the average being close to the 1919 figure of 13¾c. per pound. Market conditions show no signs of material improvement in the near future and until the company's overhead can be apportioned over a greater production this cost cannot be materially reduced.

IDAHO

Coeur d'Alene.—The Caledonia Mining Co. will disburse a dividend of $26,050 on July 5. This is at the rate of one cent per share. Quarterly payments hereafter will be at this rate.——The Bear Creek Mining Co. has shipped ore, its first carload of concentrate containing 61% lead and six ounces silver per ton. Shipments will be made at the rate of one carload per week.

Hailey.—The Silver Triumph Mining Co. has found a body of ore 6 to 15 ft. wide. One to two feet is galena rich in silver. The first samples assayed $140 in silver and lead. The ore was disclosed in clearing an old cave, and has been found to a height of 70 ft. above the upper tunnel and its dip indicates that it can be found in a raise of 200 ft. from the main tunnel. Three parallel veins lie in a zone 100 ft. wide.

NEVADA

Pioneer.—The new winze on the 200-ft. level south of the main shaft of the Mayflower has cut a full face of mill ore, with a streak of high-grade in the hanging wall. Drifting for the Starlight vein is proceeding and is expected to reach the objective within 400 ft. W. J. Tobin, president, has gone to Denver to complete further financing of the corporation.

Winnemucca.—Unwatering of the Nevada Harmony, six miles east of Winnemucca, has been completed and mining resumed. With the present pumping outfit the management expects to keep the mine clear by pumping five hours per day. G. R. Williams is superintendent.

MEXICO

Pachuca.—The El Bordo shaft of the Compania de Santa Gertrudis, Mexico, which was partly destroyed by fire, has now been wholly repaired and the mine is producing about 600 tons per day. The Santa Gertrudis company is enlarging its mill from a capacity of 40,000 tons per month to approximately 60,000 tons.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

W. H. Shockley has been examining a mine at Auburn, California.

J. C. Pickering has opened an office as consulting mining engineer at Mexico City.

George A. Packard, of Boston, was in San Francisco last week, on his way to the Mother Lode.

E. F. Orr has resigned as superintendent for the Simon Silver Lead Mines Co., at Mina, Nevada.

Glenn L. Allen, mill superintendent for the Shattuck-Arizona Copper Co., is in San Francisco.

Roy Hatch, superintendent of the Alaska Gold Mines Co.'s mill at Juneau, Alaska, is at Salt Lake City.

A. E. Chodzko has closed his office in San Francisco, and is now at 1674 Long Beach avenue, Los Angeles.

Charles A. Mitke has spent a few weeks at Morenci on professional business for the Arizona Copper Co.

Rudolf Gahl, of Denver, is now with the Cerro de Pasco Copper Corporation, at 15 Broad Street, New York.

F. B. Kirkbride has been elected president of the S. K. F. Industries, to take the place of **B. G. Prytz,** who resigned.

John E. Bergh, of Salt Lake City, has gone to Chesaw, Washington, to start development on a gold prospect in that district.

Henry H. Holden, of San Diego, California, has been in the Payson district, Arizona, examining the properties of the Atlantis Mining Co.

Charles K. Barnes has been appointed to succeed **Morris P. Kirk** as general manager for the Yellow Pine Mining Co. at Good Springs, Nevada.

Solon Spiro, president of the Silver King Con. M. Co., at Park City, Utah, recently underwent a second operation in New York. He is reported as improving.

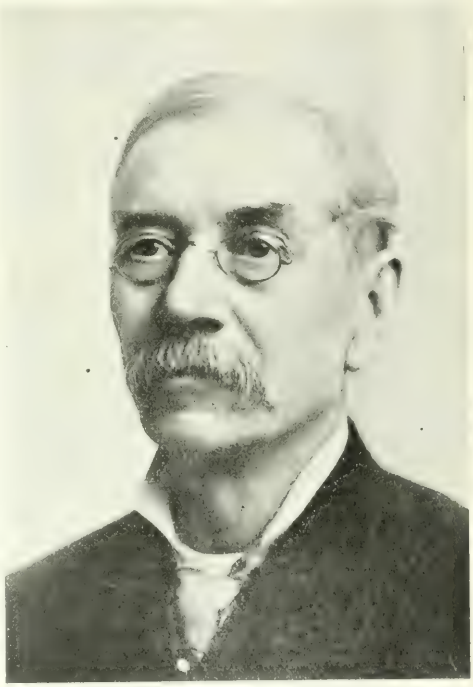
H. C. Plummer, formerly assistant superintendent of mines for the Cananea Con. Copper Co., has accepted the position of general superintendent for the Arizona Commercial Mining Co., at Globe.

Walter Lyman Brown, Director in Europe for the American Relief Association, arrived in New York on June 26 and will return to London immediately after planning winter relief operations with Mr. Hoover.

Albert Burch has resigned as manager for the Simon Silver Lead Mines Co., the Simon Sterling Mines Co., and the Simon Contact Mines Co., and, temporarily at least, is not acting as consulting engineer for any of these companies. **Oscar H. Hershey** and **Lloyd C. White** will continue to act in a consulting capacity.

Obituary

Col. Enos Andrew Wall, one of the most prominent pioneer mining men of the West, died at his home in Salt Lake City on June 29. Death was due to a cancerous growth and came after a long illness. Col. Wall was born at Richmond, Indiana, June 21, 1839, the son of pioneers from North Carolina. After a common-school education, he came West in 1860, settling in Colorado. There he became interested in mining, and in 1863 went to Montana, where he continued his search for gold, but combined his activities as a miner with those of freighter and trader. In 1868 he went to Utah, remaining there for 14 years, after which he removed to Idaho, where he became superintendent for the Wood River Gold & Silver Mining Co. While in Idaho, he was elected to the upper house of the territorial legislature and served as president of that body. In 1885 he returned to Utah, engaging in mining at Mercur, and in 1887 first became interested at Bingham, in property which later formed part of the Utah Copper Co. After selling the Brickyard mine at Mercur at a profit of $60,000, he developed the Yampa mine at Bingham, which property he later sold to Moore & Schley for $150,000, as against a cost to himself of $40,000. He held to his faith in the copper-bearing porphyry of Bingham, and in 1895, Capt. J. R. DeLamar secured an interest in the property, and in December 1902, D. C. Jackling succeeded in getting the present officials of the Utah Copper Co. interested in the project. In January 1903, Col. Wall sold a half interest in the property to C. M. MacNeill, Spencer Penrose, and R. A. F. Penrose, for which he is said to have received $420,000 and a 20% interest in



Col. Enos A. Wall

the stocks and bonds of the new company. In 1906 Col. Wall started injunction proceedings against the Utah Copper Co. when it was proposed to increase the capital stock to $6,000,000 and to issue $3,000,000 worth of convertible bonds, with the disposal of 51% of the stock to the Guggenheim interests. A restraining order was issued in this case, but later withdrawn. This was the beginning of a series of bitter legal battles between Col. Wall and the Utah Copper Co. over surface rights at Bingham. At the time of his death, Col. Wall owned approximately two-thirds of the outstanding shares of the Daly-West Mining Co. at Park City. On March 7, 1879, he married Miss Mary Mayer of Salt Lake City; this union being blessed with nine children, five of whom are living. Up to the time of his death, Col. Wall maintained an active interest in mining and Utah financial affairs, and was one of the wealthiest men in the State. He established and endowed the Wall Fellowship in Metallurgy at the Utah School of Mines at Salt Lake City. He was a man of great ability and enterprise, and kept abreast of the times in all the essentials and mining and metallurgy.

THE METAL MARKET

METAL PRICES

San Francisco, July 6

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.00
Copper, electrolytic, cents per pound	18.75
Lead, pig, cents per pound	8.25—9.25
Platinum, pure, per ounce	$85
Platinum, 10% iridium, per ounce	$118
Quicksilver, per flask of 75 lb	$90
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

July 5.—Copper is inactive but steady. Lead is quiet and firm. Zinc is dull but stronger.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid $1 per ounce for all silver purchased by it, fixing a maximum of $1.01½ on August 15, 1918, and will continue to pay $1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine) calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
June 29	89.00	52.50	May 24	100 12	58.52
" 30	91.00	52.00	" 31	101.17	58.87
July 1	90.50	Holiday	June 7	98 23	56.52
" 2	89.75	51.12	" 14	86.00	48.02
" 3	89.62	51.12	" 21	87.07	48.73
" 4 Sunday			" 28	91.41	51.69
" 5 Holiday			July 5	89 97	51.68

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	....
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	....
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
June 29	19.00	May 24	19.00
" 30	19.00	" 31	19.00
July 1	19.00	June 7	19.00
" 2	19.00	" 14	19.00
" 3	19.00	" 21	19.00
" 4 Sunday		" 28	19.00
" 5 Holiday		July 5	19.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	....
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	....
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
June 29	8.25	May 24	8.50
" 30	8.30	" 31	8.50
July 1	8.40	June 7	8.68
" 2	8.50	" 14	8.75
" 3	8.50	" 21	8.21
" 4 Sunday		" 28	8.15
" 5 Holiday		July 5	8.39

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	....
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78	....
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	....
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.88	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	....
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	....
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
June 29	7.90	May 24	7.96
" 30	7.95	" 31	7.92
July 1	8.05	June 7	8.02
" 2	8.15	" 14	8.00
" 3	8.15	" 21	7.79
" 4 Sunday		" 28	7.85
" 5 Holiday		July 5	8.04

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	....
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	....
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Date	
June 8	90.00	June 22	85.00
" 15	85.00	" 29	85.00
		July 6	90.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	....
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	....
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	....
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

THE SHIPPING BILL

J. W. Powell, directing head of the Bethlehem Ship Building Corporation, Ltd., characterizes the Jones merchant marine bill as a highly constructive piece of legislation. He says:

"There has been a marked dropping-off of ship orders during the last six months, and a discreet carrying out of the spirit of its provisions should mean more contracts. The bill grants greater authority to the Shipping Board and permits it to put into effect various policies heretofore held in abeyance. Among these are a new sales program for the 10,000,000 gross tons of war-built, government-owned shipping. The Board is enabled to sell it at virtually whatever price it decides upon, with the proviso, however, that all ships, save those not needed for our own commerce, must be sold to American men or corporations.

"For ten years, owners of American shipping can deduct from their income-tax return, the net earnings of ships engaged in overseas trade, provided that the amount of exemption be applied, with an added amount to be decided upon by the Board, to new tonnage in American yards. New government construction of merchant ships is to cease, and an annual fund, for five years, of $25,000,000 is to be created through the sale of vessels by the Board, with which to provide loans to individuals or private corporations engaged in shipbuilding for the postal service and the naval reserve. The postal authorities and Shipping Board are authorized to assist with adequate postal compensation to uphold such of our American trans-Atlantic companies which best serve the interests of American commerce. Marine insurance companies can amalgamate without fear of anti-trust laws. Bankers can do likewise for the creation of ship mortgages. To American ships is reserved the right of conveyance of all exports or imports which are granted preferential rates by American railroads."

THE MONEY MARKET

Increased discount rates can hardly be expected to do more than check further borrowing, according to the National Bank of Commerce, until the railroad situation improves so as to permit prompt liquidation of commercial and agricultural credits. In its money market discussion in the July number of its magazine, 'Commerce Monthly', the bank declares that the present partial breakdown of transportation, by interfering with the movement of products, has prevented the liquidation of a tremendous volume of credits such as is normally effected at this season of the year.

"During the period from May 16 to June 15, the money market has experienced continued tension which, largely as a consequence of the traffic situation, had become pronounced during the preceding month. The strain on credit facilities has been reflected in a further general advance in money rates. While some improvement of the traffic situation, mainly potential rather than actual, has been accomplished, it has not proceeded sufficiently to release and considerable part of the credit which had been locked up, and traffic conditions can be expected to improve only slowly. Meanwhile the credit requirements of a new crop movement will become pressing in the not distant future.

"Until the railroad situation improves sufficiently to afford an adequate physical basis for the prompt liquidation of commercial and agricultural credits, the increased discount rates of many of the Federal Reserve banks can hardly be expected to do more than check further borrowing; thereafter, they should be a strong influence in effecting a curtailment of outstanding credit, in preparation for the heavy requirements of autumn."

MONEY AND EXCHANGE

Foreign quotations on July 6 are as follows:

Sterling, dollars:	Cable	3.94½
	Demand	3.95½
Francs, cents:	Cable	8.70
	Demand	8.71
Lire, cents:	Demand	6.25
Marks, cents		2.70

Eastern Metal Market

New York June 30.

The markets are inactive or only moderately active, depending on the metal. The vacation season is also having its effect.

Demand for copper is a little better and prices are fairly firm.

The tin market is quiet but moderately strong.

There is but little demand for lead but prices are very firm.

The market for zinc is lifeless. Prices are steady, however.

Antimony is quiet and steady.

IRON AND STEEL

After two days conference at Columbus, Ohio, the prospects Tuesday night were that a shut-down of union sheet and tin-plate mills on June 30 would be averted, says 'The Iron Age'. Amalgamated Association officers notified the various lodges to continue at work pending further negotiations, and it was expected that an agreement would be reached Wednesday. The sheet and tin-plate mills of the United States Steel Corporation, in which the open-shop policy prevails, are not affected by the Columbus negotiations.

The week has brought the steel-trade no relief from the distractions of its railroad entanglements. Operations continue at a fairly high rate, but with further additions to the unshipped stocks of finished product. Failure of coke supply has stopped a number of blast-furnaces, and in eastern Pennsylvania six have been thrown idle on this account or for repairs, and in the Chicago district, two.

Four inquiries from Western roads amount to 4750 cars, which will take 38,000 tons of plates, shapes, and bars. Eighty locomotives also will be ordered by two Chicago roads. The week's buying of cars by iron and steel and coal and coke companies has brought the total of such cars placed in June to about 6000.

COPPER

Sentiment may be pronounced a little better. This is probably due to improved demand for forward delivery, particularly last quarter. Sales of electrolytic have been made at the full price of 19c., New York, for delivery in, and through, the last quarter as well as for earlier positions, but demand is not heavy. There is also a heavier inquiry from foreign sources, England and the Continent, and substantial sales have resulted. Aside from these features basic conditions are unchanged, the industry being still more or less hampered by railroad and other troubles. The quotation of leading producers is firm at 19c., New York, for third quarter for both Lake and electrolytic copper. In the outside market varying quotations are obtainable as low as 18.25c., New York, for early delivery, but it is not believed that large quantities are involved. Exports of copper are on the increase, having been 39,415 tons in May. It is believed that for the first six months they will average 30,000 tons per month. In 1919 they were less than 1900 tons per month.

TIN

The market has been an uninteresting one with no pronounced tendency. For the greater part of the past week it has been dull with consumers manifesting little desire to buy. Most of the transactions have been among dealers. About 300 tons was sold last week up to Saturday on the New York Metal Exchange, 200 tons of this on Friday. It was all for future shipment in various positions at prices ranging from 45.75c. on Friday to 49.50c. last week Wednesday. At the close of the week sellers were shy when demand was fairly good with 46.25c. paid on Friday and 47c. on Saturday. On both these days there were more buyers than sellers. This situation was also true early this week when 46.75c. was bid and 47c. asked for futures and 48.75c. bid and 49c. asked for spot. This bulge in spot tin over the future price is explained as probably due to a covering of short contracts for June delivery; when this is over, it is expected that the two prices will be more nearly on a level. Spot Straits yesterday was quoted in New York at 48.50c. per lb. and at £260 per ton in London. A week ago the London price was £270. Arrivals to date this month have been 3280 tons with 4195 tons afloat. Spot Straits continues scarce.

LEAD

The market is quiet but firm and featureless. It appears that consumers and buyers are comfortably supplied for their nearby needs and perhaps further ahead and hence manifest no interest in buying. Producers are believed to be catching up in production of the metal only slowly and hence are not pressing sales. As a result the market is stale and drifting. The leading interest's quotation is unchanged at 7.75c., St. Louis, or 8c., New York, for early delivery. That of the outside market is 8c., St. Louis, or 8.25c., New York.

ZINC

The market continues inactive and devoid of features. If anything, however, it is a little firmer than a week ago. Demand is still confined to intermittent orders which producers are filling at prevailing quotations. Prime Western for delivery in the third quarter is quoted at 7.55c., St. Louis, or 7.90c., New York.

ANTIMONY

This market is quiet with wholesale lots for early delivery quoted at 7.50 to 7.75c., New York, duty paid, depending on the grade.

ALUMINUM

Quotations for wholesale lots for early delivery are unchanged at 33c., New York, by the leading producer, with 31.50c. asked by other sellers.

ORES

Tungsten: In the absence of any domestic buying, even at lowered prices, it is reported that sales have been made for export at $5.75 per unit. Some interest is awakened by these sales as well as considerable speculation.

Ferro-tungsten is unchanged at 85c. to $1.15 per lb. of contained tungsten.

Molybdenum: Entire lack of interest characterizes this market and prices are nominal at 65 to 75c. per lb. of MoS_2 in regular concentrate.

Manganese: There is not much demand just at present and quotations are a little easier. About the best price that buyers would pay at present is 70 to 75c. per unit for high-grade ore for early delivery.

Manganese-Iron Alloys: Demand for ferro-manganese continues light. A sale of 185 tons for fairly early delivery at $190, delivered, is reported, but special considerations are said to explain the low price. For last half the quotation of producers is regarded as firm at $200, delivered, with $225 asked for prompt. Some British alloy is available for shipment from August on at $195, seaboard. More demand characterizes the spiegeleisen market which is very firm at $75, furnace, for all positions. There are domestic inquiries aggregating 1000 tons for fairly early delivery as well as one for 4000 tons for foreign shipment.

T. A. RICKARD, - - - - Editor

THE Missouri School of Mines and Metallurgy at Rolla has issued a booklet that contains the records of students and alumni who engaged in military service during the War. Of 273 American undergraduates enrolled, 207 entered the military service, and 23 others were in the Students Army Training Corps. Still others were engaged in work of production at which they were urged to remain in preference to enlisting. In all, 600 Missouri School of Mines men were in active service.

ON August 10 the Secretary of the Interior, Mr. John Barton Payne, will hear arguments in behalf of claimants under the War Minerals Relief Act in regard to questions under dispute with the Commission functioning under that Act. The hearing was granted at the request of the American Mining Congress, following the receipt of hundreds of letters on the subject. Arguments on the following points will be submitted: request and demand, purchase of property, net losses, and commercial importance. The status of the Commission and its method of procedure will also be discussed.

BY courtesy of the Director of the U. S. Bureau of Mines we are informed that the Secretary of the Interior has formally approved the transfer of the Mining Experiment Station that was established at Denver in 1910, and moved to Golden in 1917, to Reno. This station will be known henceforth as the Rare and Precious Metals Station and its work will be conducted in cooperation with the Mackay School of Mines of the University of Nevada, which is at Reno. This change seems, on the face of it, to be well considered; it will be a source of strength to the Nevada School of Mines, and also a matter of convenience to those in the field most likely to derive benefit from it.

NINETY mining companies, including practically all of the large producers of zinc and lead in the Tri-State district, which centres at Joplin, have agreed upon a plan of curtailment that is expected to force the price f 'ore' to $60 per ton. The first step is a complete shutdown for two weeks during the early part of July. This is to be followed, so it is reported, by other periods of idleness, to the end that production may synchronize with demand and the price for the product may thereby be maintained at a higher level. While the operators point to the fact that their employees, who have worked steadily for several years, should appreciate a short vacation, and that at any rate those who desire can work on the farms where there is an unfilled demand for help, we are somewhat skeptical as to the result of repeated unsought holidays on the attitude of the miners. There is the possibility that the employees may assist in the curtailment and make temporary shutting-down unnecessary by the simple expedient of 'tapering off' more frequently and persistently. They may reason that, since the demand for their labor is limited, the market can best be supported by a co-operative plan of curtailing the rate of production per man; and the operators would not have a particularly strong argument against such a policy.

AMONG the documents received by us recently is the annual report of President Butler on the work of Columbia University. Owing to our interest in that university and its distinguished head, we looked over the report, expecting to find something interesting. We did. Among the more prosaic items we note that full professors are now paid $6000 to $8000 per annum, "with the expectation of paying salaries of $10,000 to a limited number of teachers of unusual distinction". We like the use of the word 'teacher' in this context; every professor is not a good teacher; a "teacher of unusual distinction" is worth his weight in gold to a university, and to a community. In 1919 the Carnegie Foundation paid $60,000 to the Treasurer of Columbia University in retirement and disability allowances. Altogether the Foundation has given Columbia $405,439 in 13 years. The President reviews the changes in the university's chief interest: for fifty years the centre of gravity lay in the classical languages and literatures. "It then moved, with results that were not entirely satisfactory, to the natural and experimental sciences. From these it moved to the field of social and political science, and there perhaps it rests at the present time, although in a state of unstable equilibrium." This is as noteworthy as it is satisfactory. The first purpose of the university is to produce good citizens, the highest type of citizenship. For such the scientific study of economics is imperative.

IN a report filed with the State Public Utilities Commission of Utah, which is investigating certain special contracts under the terms of which the Utah Copper Company purchases its electric power, Mr. John M. Hays, treasurer for the company, gives some interesting

data. The company has treated since 1907, when operation commenced, 75 million tons of ore from which was recovered one and a half billion pounds of copper, 416,000 ounces of gold, and 4,400,000 ounces of silver. The metal content of this ore averaged less than 1.5% copper. The company's property, which includes the Bingham & Garfield railroad, was appraised for taxation in 1919 at $58,000,000, or practically 9% of the assessed valuation of all property in the State. From January 1, 1913, to January 1, 1920, the company purchased 900,853,060 kilowatt-hours of electric power, for which it paid $4,034,426 to the Utah Power & Light Company. Indicative of the importance of the mining industry to Utah is the fact that of 72,740 wage-earners employed in the State in 1918, 22,022 or more than 30% were engaged in the mines, mills, and smelters. In 1917 the mines produced metal to the value of 99 millions, and in 1918 the output totaled 86 millions, while the ore hauled in that year accounted for 85% of the total tonnage handled by the railroads. While Utah has other natural resources, she certainly can ill afford to hamper the mining industry.

ANY machine whose motion is rotative has certain decided advantages over one of the reciprocating type. It has fewer bearings, it is more compact, weighs less, requires lighter foundations, demands less attention, and costs less than a reciprocating machine designed for the same work. Steam-turbines, turbo-compressors, and centrifugal pumps are built on the rotative principle and for many uses are rapidly displacing older machinery. In spite of the fact that centrifugal pumps rarely have an efficiency of more than 75% the other advantages are so great that their use in mines and mills is constantly becoming more general. For underground pumping, high-pressure multi-stage pumps are required, but these have been developed to such an extent that suitable equipment can be obtained for any service. Centrifugal pumps, however, are peculiar in that they work advantageously only under the conditions for which they are designed. The quantity lifted, the head pumped against, and the speed of operation, each must coincide closely with that for which the pump is built, if a reasonable efficiency is to be obtained. The principles on which the pump performs are unusual. We happen to remember a large and successful mill where a standing order directed the operators to open the valves in the discharge-line before starting centrifugal pumps on the theory that otherwise the motors would be subjected to extra strain when starting. As a matter of fact the shut-off load, as it is styled, when the discharge-line is closed is the minimum and the facts directly contradicted the theory on which the mill superintendent based his instructions. In this issue we publish an interesting and valuable article on centrifugal pumps by Robert S. Lewis, Professor of Mining in the School of Mines at the University of Utah.

IT is said of Jefferson that he did not think it ridiculous to state that were it left to him to decide whether they should have a government without newspapers or newspapers without a government he would not hesitate a moment to prefer the latter. Mr. Bryan's proposal to establish a government newspaper, for the avowed purpose of giving reliable news, reminds us of this saying of the father of the Democratic party. We were glad that Mr. Bryan's proposal was defeated at the recent Convention, all the more as we had read of Secretary Daniels disembarking at San Francisco from a warship to the salute of seven guns and in the company of Mr. George Creel. If there be a *bête noire* to American journalism, it is Mr. Creel. To think of a government paper edited and controlled by him would provoke mingled derision and resentment. In truth, most of us are tired of bureaucratic interference with legitimate industry and to have the Fourth Estate subjected to the unintelligent tyranny of such a man as Creel is unthinkable. The defects of democratic government are obvious enough, and the only hope of amelioration lies in the criticism of a free press. Even the license of a string of disreputable papers, like Hearst's, is preferable to the subordination of journalism to a petty official at Washington. Sane criticism is the best cure for the ills of maladministration; upon the development of healthy public opinion rests the welfare of representative government in this, or any other, republic.

ELSEWHERE in this issue we publish a particularly valuable article by Mr. Gilbert Rigg, metallurgist for the Broken Hill Associated Smelters Proprietary, Ltd., describing recent improvements in lead smelting as practised at Port Pirie, South Australia. The smelting of galena ore in the blast-furnace, following a preliminary roast for the removal of part of the contained sulphur, is comparatively old, the principal advance during recent years being the development of blast-roasting. Although the early edition of Hoffman's standard treatise on the metallurgy of lead antedates the use of Huntington & Heberlein pots, and the introduction of the Dwight & Lloyd sintering machine came still later, it seems fair to say that lead smelting has been looked upon as being a rather commonplace operation, which depended for its success largely on plenty of flux and good furnacemen, and that, if not actually neglected by the metallurgist, it has at least not been studied as zealously and assiduously as have some of the newer processes. Mr. Rigg deals in a thorough and practical way with actual problems of a nature similar to those that present themselves to every smelter superintendent. For instance, he says that a foreman in charge of the Dwight & Lloyd department found that the sulphur content of the sinter he produced varied, not directly but inversely, as that of the material received from the pre-roasters. This seems paradoxical, but it was true. It appears that the pre-roasting was done on a primary Dwight & Lloyd machine, the product from which was crushed by rolls in preparation for the second treatment. The better the pre-roast, the harder was the sinter, and the greater was the proportion of coarse material in the crushed product. Less sulphur was then removed in the second roast and the sulphur content of the final sinter was accordingly high. The improvements made at the Port Pirie plant

illustrate the value of intelligent and painstaking research and experimental work and suggest in particular, as Mr. Rigg concludes, that the "last word has not yet been said in regard to the method of blast-roasting the ore and smelting the sinter in blast-furnaces".

THE effort to prosecute those responsible for the Bisbee deportations of July 1917 seems unlikely to lead to any convictions. The first test case ended in an acquittal on April 30 at Tombstone, as recorded in our issue of May 15. The next case is set for November, but we think it unlikely that it will come to trial, owing to the apparent difficulty in persuading any jury that a crime was committed, even if a blunder was perpetrated. On the other hand, it is pleasant to recall the fact that out of the Bisbee trouble there has come one good result at least, namely, the adoption of the scheme ordered by the President's mediation committee, of which the Secretary of Labor, Mr. William B. Wilson, was chairman. The managers of the mines and their employees were compelled to adjust their quarrels by means of a grievance committee, the members of which had to be elected by secret ballot and on neutral ground. Any complaint from the employees is referred to the grievance committee, which either rejects it or takes it up with the manager; in case of disagreement the matter is then referred to a Federal mediator, who, although he has not the actual powers of an arbitrator, is virtually enabled to act as such, because in every case so far his decision has been accepted by both sides. This arrangement will continue so long as a state of war persists; it holds good for all the copper mines of Arizona; and in effect it settled the labor controversy in the South-West for the term of the War. We hope that it may become established, for it works admirably. Among its minor features it is noteworthy that the men, by reason of the secret ballot, showed good judgment in the selection of their representatives, choosing both union and non-union men, much to the chagrin of the walking delegates but greatly to the satisfaction of those, managers and men alike, who earnestly desire to promote fair play in industrial affairs.

The Conventions

In a recent article Señor Blasco Ibañez remarked that the people of the Latin countries are restrained by the fear of the ludicrous. He might have included the British; their sense of humor likewise is largely perverted into a dread of making themselves ridiculous. This is intimidating; it is tyrannous; Ibañez likens it to the fear of the inquisition, and then proceeds to say, apropos of the suffragette picketing at the Chicago convention, that in a Latin country "it would be impossible to assemble a dozen ladies of respectable age and dimensions to dress themselves up like schoolgirls and parade in the streets. The thing would strike them as utterly preposterous". It would indeed, and that may be why, lacking the courage, the Spanish and Italian women have not won the vote. The conventions at Chicago and San Francisco proved our people indifferent to any fear of seeming absurd; they made themselves intensely ridiculous by their antics and yet retained their self-respect. Macaulay's New Zealander or Butler's citizen from 'Erewhon' would have been moved to homeric laughter, not wholly good-natured perhaps, at the performances that preceded the selection of the next President of the United States. Even to the sophisticated and comprehending spectator, to the thoughtful student of our political system, the antics of the political mobs that represented the two dominant parties in the nation affords cause for regret and chagrin. The organized applause, the hired bands, and the paid yell-leaders were hardly worse than the opening invocation, which simulated a prayer to the Almighty while really only a speech to the audience, or the exploitation of the national flag and the national anthem alike in the interest of the individual candidate. Of the many speeches, most of which we read, for our sins, we recall only one that we would be willing to read again, and that was the opening address by Mr. Homer S. Cummings. The other key-note address, by Senator Henry Cabot Lodge, left an unpleasant taste of personal rancor toward a stricken man and of narrow partisanship unrelieved by any touch of generous vision. Much the worst nominating speech was that of Mr. Charles S. Wheeler in support of Senator Hiram Johnson and the best that of Mrs. Douglas Robinson in seconding General Wood. The most effective nomination was that made by Mr. Frank B. Willis, who closed a short speech by saying: "Well, boys and girls, let's nominate Harding." Mr. Willis, by the way, was the man who defeated Mr. Cox for the governorship of Ohio in 1914. Another felicitous recommendation was that made by Mrs. Jewel Brown, who said of her candidate, Mr. John W. Davis: "He is not a preacher but he practises what the preachers preach." These were rare flashes amid the fog of platitudinous piffle. As for the platforms, both are a mass of evasive verbiage. The Republican contains 6396 words; the Democratic is equally long. As Mr. Woodrow Wilson said during the 1912 campaign, "A party platform is not a program". It is an elaborate gangway for stepping into power, a political posturing that deceives some and binds nobody. Both conventions were essentially political mobs that came to heel at the call of the bosses. That was inevitable; without bossing they would still be mulling around in helpless confusion. At Chicago the crowd of politicians was moved scientifically by the old machine in the masterful hands of Senator Penrose. The reactionary element, representing a highly organized phase of predatory politics, won easily. A 'regular' was nominated, a colorless docile henchman was made the standard-bearer. Whereas the present incumbent of the presidential chair has assumed an autocratic power repellant to thousands of good citizens, his proposed Republican successor is a second-rate politician who is expected to be wholly amenable to a senatorial coterie. The pendulum will make a full swing if the Republicans succeed in electing Senator Warren G. Harding. In San Francisco the Presidential machine dictated the platform and ensured a tribute of praise to

the outgoing Chief Executive, but it declined to nominate a candidate recommended by Mr. Wilson. Here the bosses became effective by distributing the votes of the pivotal States, those of New York, Illinois, and Indiana, in such a way as to defeat the forces of the Administration and after systematic delay compel the nomination of Governor James M. Cox of Ohio. He is a man of some character and considerable achievement, but it is unlikely that he will win the race under the handicap of the outgoing Democratic regime. To earnest men the forthcoming election presents no scope for enthusiasm, and yet we agree with Mr. Hoover that those of liberal mind must do the best they can from within the existing parties. A third party would make for a confusion subversive of our political system. For the present the sanely progressive elements whom Mr. Hoover would have represented are submerged. They may make themselves felt in the cabinet of the next President, for it is quite probable that a weak man will fortify himself by selecting strong men for his cabinet, in contrast to a President of strong character who filled the offices of State with weak men. Co-operation between the Executive and Legislative branches of the Government is essential; the experience of the last twelve months is eloquent on that point. It even seems a pity that the selection of a President, who is the chief of a victorious party, is not left to the members of that party in the House of Representatives. Originally, under the Constitution, the electors were highly respected citizens chosen from each State with authority to select a President. Owing to the inability of men who were unknown to each other to concur in a choice, the arrangement broke down; so eventually the electors accepted a mandate from the electorate and became the mere recorders of the popular vote. This led to the party ticket, which is the expression of a choice made at a party convention. Today, thanks to improved transportation and communication, the system as originally devised under the Constitution would work much better than it did a century ago and it would probably lead to the choice of men of a higher type. A thousand men in open assembly never did, and never will be able to function intelligently in the choice of a representative. In a multitude of counsellors there is only noise. So long as the present system survives, the nomination of a president will fall into the hands of those small groups of quick-witted men we call political machines. Sometimes they are outwitted by Providence and we are given a Lincoln or a Roosevelt, but most of the time they give us the cigar Indians of the political sidewalk.

News From Mexico

Letters from Mexico bring cheerful news; there is an increasing confidence in the near prospect of a restoration of order and it would appear as if the provisional government of De la Huerta were being well established, in preparation for the general election of September, when General Alvaro Obregon is assured of election to the Presidency. Officials at Washington are watching the course of events closely with a view to determining when it will be proper to recognize the provisional government, which is the *de facto* successor of the Carranza administration. Señor Iglesias Calderon, a special envoy from Mexico, is now at Washington making every effort to persuade the Acting Secretary of State that his government is worthy of recognition and support. We hope recognition will be accorded soon, for it will help to confirm the status of the existing order and facilitate the financial arrangements necessary to the rehabilitation of the railways and other industrial activities of a mining region in which our people have a large stake. Complaints reach us that the representatives of mining companies find themselves still facing many of the predatory officials appointed by Carranza; as yet apparently the new government has not been able to make a clean sweep. We would counsel patience; give President De la Huerta a chance; in the land of *la mañana* it is necessary to allow for the element of time even when the best intentions actuate the policy of a government that has just jumped into the saddle. The resumption of order and the revival of industry in Mexico must be left to the Mexicans themselves; the recovery of the country must be brought about mainly by the forces from within, not by interference from outside. The Mexican planks in the platform of our two parties are humorous. The Democrats give credit to the Wilson administration for the recent improvement south of the Rio Grande, whereas, of course, the vacillating policy of Washington during recent years has served chiefly to aggravate the troubles of our so-called sister republic. The Republicans echo the truculent tone of the Fall resolution, and expect Mexico to amend her constitution to suit our desires, but if we can persuade our neighbor in a friendly way not to give a retroactive interpretation to the clause nationalizing the subsoil we shall have done as much as we can do in that direction. For the rest, all the miner asks is life, liberty, and the pursuit of his occupation under a civilized code, whereby the Mexican government will not discriminate against him so long as he obeys the laws of the country; and in doing his legitimate work he asks for the protection of his own government whenever or wherever his just rights are invaded or suppressed by any other government. Several minor revolutionary outbreaks have been reported during the past month, but they represent, we hope, the crackling of vagrant sparks of unrest on the edge of the latest revolution. Villa is still at large and is trying to bluff the authorities into recognizing him as a political unit. He has ceased to be that, and if the new government is to receive recognition it devolves upon it to perform its proper function by extinguishing this vile ruffian, who has too long menaced life and property in the North. The rehabilitation of the railroads and the restoration of the school system are the two primary needs of Mexico. After that, and while these reforms are in progress, we may hope for a re-establishment of conditions favorable to industry. Not for ten years have the prospects been so good for the miner in Mexico.

The Camp Bird, Mr. Agnew, and Mr. Spurr

The Editor:

Sir—I had occasion some little time ago to write to the editor of the 'Engineering and Mining Journal', New York, calling his attention to the incorrectness of some remarks published in that journal on 14th February last. Since the date of that letter I have carefully sought for its publication, an acknowledgment of error on the part of the editor, or a reply direct to me, in each case without success. I conclude therefore that the editor of the journal in question intends to ignore my communication. I enclose herewith a copy of the latter and I shall be grateful if you can arrange to publish same in the 'Mining and Scientific Press', together with this explanation.

JOHN A. AGNEW.

London, June 14.

Copy of letter follows.

No. 1, London Wall Buildings,
London, E. C. 2.
10th March, 1920.

The Editor,
Engineering & Mining Journal,
New York, U. S. A.

Sir—My attention has been called to the paragraph in your issue of 14th February, relating to the Camp Bird deep tunnel.

It is a matter for surprise that you should not have taken steps to ascertain the correctness of the statement to effect that the mine had been shut down before publishing same. It is true that you mention it as being reported to you, but the deductions you draw therefrom and the peculiar satisfaction expressed, leave no doubt as to your belief in the report.

As one of the technical advisers to Camp Bird Ltd., I may be permitted to reply to your remarks. Some years ago—to be accurate, in 1908—Mr. J. E. Spurr was called on to advise the Camp Bird directors as to the policy to be followed in further development work. In the east end of the mine the then lowest working was the No. 3 adit-level. In the course of an exhaustive report, made no doubt after an examination of a similar character, Mr. Spurr advised the board that any further work below the No. 3 adit would be useless and unproductive: in spite of this advice the board decided to sink No. 3 shaft and between No. 3 adit-level and the ninth level—a vertical distance of about 1000 ft.—in a short shoot of ore in the vicinity of the shaft referred to, there has since been extracted ore which has actually yielded a profit of over £500,000.

To sink below the ninth level would have meant enlarging No. 3 shaft and the installation of much heavier winding and pumping equipment: there was, moreover, the constant danger of the workings being flooded if any connection were established with certain water courses believed to traverse the No. 1 shaft section, the latter being an extremely wet section. These factors caused the directors, largely on the advice of the writer, to agree to the driving of the tunnel now referred to. It did not seem too much to ask that a moderate percentage of the profits won from the shoot of ore above referred to should be set aside to seek for its continuance in depth, especially when the then lowest level—ninth—appeared promising.

Whether Mr. Spurr's opinion was sought, in earlier years, in order that the directors might have the benefit of his advice on driving a low-level tunnel, I do not know: I do know, however, that it was not asked for when the question of driving the present one was under discussion.

The Camp Bird mine is not shut down; work is actively proceeding in the eastern section—the one referred to above, and a commencement is being made to extend the west drive on the vein, at the tunnel level, under No. 1 shaft section.

Am I right in assuming that the Mr. J. E. Spurr, mentioned in the paragraph I have drawn attention to, has no connection with Mr. Josiah Edward Spurr, the editor of the 'Engineering and Mining Journal', or is it permissible for one of them to seek a cheap form of notoriety while the other has a sneer for a body of men possessing what is often enough lacking today in mining—a little pluck and enterprise?

Yours faithfully,

JOHN A. AGNEW.

[We know Mr. Agnew to be a distinguished member of the mining profession and a man of the highest character. We are willing therefore to give him the space to make this protest. Why Mr. Spurr did not publish it, we are at a loss to surmise.—EDITOR.]

Professional Ethics

The Editor:

Sir—Referring to your critical editorial upon the code of ethics proposed by the American Society of Mechanical Engineers, I would call attention to that adopted by the American Society of Civil Engineers in 1914, which reads as follows:

It shall be considered unprofessional and inconsistent

with honorable and dignified bearing for any member of the American Society of Civil Engineers:

1. To act for his clients in professional matters otherwise than as a faithful agent or trustee, or to accept any remuneration other than his stated charges for services rendered his clients.

2. To attempt to injure falsely or maliciously, directly or indirectly, the professional reputation, prospects, or business, of another Engineer.

3. To attempt to supplant another Engineer, after definite steps have been taken toward his employment.

4. To compete with another Engineer for employment on the basis of professional charges, by reducing his usual charges and in this manner attempting to underbid after having been informed of the charges named by another.

5. To review the work of another Engineer for the same client, except with the knowledge or consent of such Engineer, or unless the connection of such Engineer with the work has been terminated.

6. To advertise in self-laudatory language, or in any other manner derogatory to the dignity of the Profession.

Article III, Clause 6 of the constitution of the society provides for the expulsion of a member for cause. Unprofessional and dishonorable conduct would clearly constitute such cause. This code is simple and brief. Means of enforcement, or rather of punishment for breach, are not wanting and I believe have been exercised upon one or more occasions in the past.

San Francisco, July 3. ROBERT HAWXHURST JR.

Question and Answer

The Editor:

Sir—In your issue of June 26 you invite criticism of your book on technical writing. The following is not a criticism, but a suggestion. The suggestion I would make is based on the benefits I have received from a certain work on mining, namely, Mr. J. E. Spurr's 'Geology Applied to Mining'. I have got more out of Mr. Spurr's book than all the books on mining I have ever read. I believe this is due to the manner in which the subject is presented, that of question and answer. The answers to questions are easier found and are easier fixed in the mind. I believe it would be an improvement if all subjects were presented in the same way, at least to the beginner. It may be that this method of presenting a subject is not suited to addressing those who already know a great deal about it.

Not only is it an advantage to present a subject this way, at least to a beginner, but it is, I believe, an advantage to a writer in preparing his subject, even if he doesn't present it to his readers that way. The following will illustrate what I mean. Just before the War I put in two years prospecting in Central Africa for a mining company; and, for my own satisfaction, I worked out the best way of doing every part of my work. In this I was greatly assisted by using the method of question and answer. Following is an example.

Cutting down the cost of prospecting. What items enter into the cost of prospecting? What is practically a salary and expenses from the time a prospector leaves America until he returns, his food while in Africa, the cost of administration, the wages and up-keep of the men in his employ, his outfit and tools. What does all this amount to? I can't say exactly, but for the purpose of discussion I will say about $7000 for the term. How much time does a man spend in the field? About 19 months at the most. Then according to these figures it costs at least $12 per day for the time a man is actually prospecting in the field? Yes. Are there circumstances under which it may cost more? Yes. What are they? Sickness and loafing. Then it pays the company for a prospector to pay considerable attention to his health? Yes. Does good management cut much figure in the cost of prospecting? Yes, a very big figure. In what ways can a man increase his effectiveness in the field? By not doing anything more than is necessary in finding what is wanted; and by devising ways and means of doing quickly what is to be done. What do you consider the most desirable thing to find? Big enough bodies of ore and gravel of a grade that it will pay to put in railroads, etc., or reduction plants. Why not put in a great deal of time looking for small bodies of high-grade ore and gravel? Because the chances are greater to make more out of the big lower-grade bodies of ore and gravel. It is a law of mineral distribution that the amount of mineral in rich veins and deposits is small as compared to the amount in lower-grade veins and deposits. This law is a very important factor in mining. Don't you think it would be profitable to pay more attention to the small high-grade ore and gravel deposits? It is not a question of what is profitable, it is a question of what is most profitable. If railroads or machinery were put in on account of big low-grade stuff, the small rich stuff would then become more profitable. What do you consider unnecessary work? Accurate surveys of streams, trails, routes, or lodes, and the surveying of small streams unless they are to be prospected to get more detailed information. The sampling of small streams, or at least an extensive sampling of them, when the streams around them have not proved good. And sampling any stream any further than to draw comparisons with the best or until we wanted to know the amount of gold in it with the idea of exploiting it. The building of trails any better or putting any more time on them than the amount of travel warrants. Or building houses any better than the length of time they are to be occupied warrants. The cutting of plantations when it is possible to get food from the outside. The planting of anything that won't mature soon enough to be used. In what other ways can a man do prospecting cheaper and quicker? By employing outsiders to do all the work than can be done by outsiders, such as cutting trails, leaves for houses, sticks, clearings, plantations, porterage, etc., and using the services of various *chefs de postes* and commercial agents in arranging for food and porterage. May not the employment of outsiders to do all this work cost more? It would appear

so if we only consider the wages and up-keep of one's own men without considering the cost of administration, the salary and expense of the prospector from the time he leaves America until he returns. But if we consider these items it would have to cost considerably more than it does to be profitable for one to use his own men for this work. Every day one loses in actual prospecting costs at least $12. By employing outsiders we make a more effective use of the over-head expense—the constant expense.

The method of question and answer can be employed to great advantage in working out the problems of any business. It is surprising how readily some pretty knotty problems can be solved by putting down questions as they occur to you and then answering them. Every question when uttered seems to call forth an answer and every answer seems to suggest another question. Try it. The effect is a little surprising. By asking a question we give ourselves a definite task to perform, which helps immensely.

At all times a writer, in discussing a subject, is answering questions, only he doesn't utter them or write them down. By writing down the questions or uttering them the writer gets a clearer and better idea of his subject. He may afterward, in presenting his subject, omit the questions.

WM. CROCKER.

Prescott, Arizona, July 1.

[It so happens that we drew attention to the usefulness of Mr. Spurr's book, on the application of geology to mining, in our issue of June 26 (page 927). We agree with Mr. Crocker that the value of this handbook is enhanced by the method of question and answer. Undoubtedly the written record of questions pertinent to any subject under discussion helps to fix the essential points, but most men try to accomplish this by making mental notes.—EDITOR.]

Electric Detonators

The Editor:

Sir—The article on this subject in your issue of June 19 is most interesting. However, the recommendation about a three-pole switch will not, in my opinion, eliminate the most common causes of misfires. In the fourth paragraph of their conclusions, the authors of the paper suggest two objections to the use of delay-action exploders in cut-holes, and recommend the use of instantaneous exploders. While their suggestion is feasible, provided the three-pole switch be used as described, it is directly contrary to the recommendations of the mining division of the Industrial Accident Commission that instantaneous exploders shall not be used in the same circuit as delays. It is possible with a lighting current and a three-pole switch having one leg shorter than the other two, to use the instantaneous exploders in the same circuit as the delays. If a lighting circuit is not used there is no way to use the combination successfully. Delay-action detonators as a rule are so made that the first delays are timed to pull the cut-holes satisfactorily, and they can be used with any kind of current, provided the wires are properly connected.

The authors also make a point of the fact that misfires may occur by using delays in the cut-holes. There is no more of a chance of electrical failure in using No. 1 delays than there is in using instantaneous detonators.

Again, referring to the three-pole switch discussed in this article, it should be borne in mind that this method is liable to cause trouble unless one of the poles is considerably shorter than the other two poles in the switch, and unless the contact is made very slowly at the time of throwing the switch. Moreover, users must be sure that they do not get a lead wire from the delays connected to the short pole. It is essential that the delays be ignited first, hence they must be connected to the long pole. All of these points are likely to be neglected by men who do not appreciate the need of care, with the result that men may be injured by accidents due to misfires.

G. CHESTER BROWN.

San Francisco, July 1.

Apex Litigation

The Editor:

Sir—I have been a frequent reader of your paper. Your appeal for aid to help solve the apex problem no doubt will attract the attention of many mining men of this country. The time is most appropriate to make an attempt to correct the many mistakes made concerning the present procedure in apex cases in court.

In response to that call you will please find enclosed a printed sketch or map showing the vein system of the Coeur d'Alene district with the Bunker Hill vein as the mother vein of the entire system. This map represents approximately thirty miles of the Bunker Hill vein, including the later veins of note that branch out from both foot and hanging wall. If there was an extension of thirty miles more added to this map it would then fail to reach either end of this great vein. There is nothing in connection with this map and the lines representing the veins of the Coeur d'Alene that has been borrowed from anyone—not even from Germany. And, furthermore, there is nothing I can borrow from geology as it is being taught in our higher institutions of learning concerning the structure and the power that have created all mineral veins and earthquakes. Strange as it may seem, the earthquake that occurred in Old Mexico a few months ago sent an electric wave through every vein in this Coeur d'Alene vein system.

I have devoted a great deal of time and energy regarding this nation-wide apex problem, which has been the cause of so many serious conflicts in the mining industry. In many apex suits the testimony introduced by geologists has been so contradictory that no judge or jury could give an intelligent decision. In some cases the judge is accused both by the public and the defendants in the case as having shown some partiality in his decision. The general impression prevails that geologists

testify for the side that pays them. Such is not the case. Geologists testify honestly, each for himself along the lines that he has been schooled and trained. It has been suggested in the last few years, why doesn't the judge employ a third set of geologists to testify for the Court, that he may arrive at a non-partisan decision. The result would be that such a procedure would give the judge one more color to choose from, with no better results.

The first serious mistake is made by the prospector who does not locate a claim properly along the trend of the vein or apex. There is no branch of mining that requires greater skill in mining than the developing of a prospect into a producing mine. There are a great many cases that I can refer to, two in particular, where the Federal Mining Company undertook to develop the Bunker Hill vein between Government gulch and Pine creek. After spending approximately $200,000 they did not touch that great vein at any point. On the Senator Clark vein on Sunset mountain, after spending an enormous amount of money in development work, they do not know whether the vein they should have developed is six feet wide or one hundred feet. Those are conditions that confront us today, that make mining such a hazardous risk.

The time is near at hand when those who testify in mining suits, especially as to the apex of a vein, must prove it by some method. Theory has got to be such a vexed question in past years. If those that are interested in mining and the higher institutions of learning would recognize the great almighty power, electricity, that has created all things, then, and not till then, will this apex problem be solved.

There is so much that can be written on this subject, other than that taught by high institutions of learning, that when the time comes that I must defend the apex of a vein in court the problem will be solved along the lines as expressed in this paper.

JOHN J. PRESLEY.

Kellogg, Idaho, June 28.

[We publish this letter, although we are not in agreement with the writer's views in regard to the part electricity plays in the formation of veins; as to that we plead ignorance; but we do wish to endorse Mr. Presley's suggestion that the locators of claims should take more care to ascertain the strike of the vein they desire to exploit. Much of the litigation is due to random locating. EDITOR.]

Copper in China

In 1918 over 8000 short tons of copper ingots and slabs valued at about $5,000,000 was imported into China. An increased amount was imported in 1919. The imports for the first three-quarters of that year amounted to over 14,000 tons, but final figures for the total year's importations are not yet available. Practically all of this copper came from Japan and was minted into coins. Recently some American copper has reached China through the Japanese dealers. Copper has been used in China since before the Christian Era; it forms a large part of the old bronze objects of those days. The metal has been produced in China for centuries, but never, so far as there are any records to show, in quantities which today would be considered of importance. Many occurrences of copper ores are known, but so far no large copper mines have been developed. These ores are scattered throughout a number of the provinces of China and the copper produced is derived from these small properties. The production of copper in China now amounts to about 2000 tons annually which does not nearly supply the demand. Copper probably has a relatively larger utilization in China than in other agricultural countries. Copper objects of art and brass utensils are quite common. The brass 'cash' pieces, 10 to the cent, and the large 1-cent and 2-cent copper pieces which are, by the way, much larger than the coppers of the United States, are in use everywhere. The 2-cent piece is about the size of the American silver half dollar and the 1-cent piece is, approximately, one-quarter of an inch less in diameter.

According to the Chinese maritime customs, imports of copper bars, rods, sheets, plates, nails, and wire amounted to 1,276,266 lb. in 1916, 1,376,400 lb. in 1917, and 1,380,933 lb. in 1918; imports of copper slabs and ingots totaled 3,474,000 lb. in 1916, 3,687,733 lb. in 1917, and 16,187,733 lb. in 1918. The final figures for 1919 are as yet unavailable, but the total tonnage for the first three quarters of the year was 28,973,200 lb., showing that a further large increase took place during that period. Japan furnished 3,206,800 lb. in 1916; 212,000 lb. came from the United States and possessions; 212,000 lb. was credited to Great Britain. The share of Japan increased to 3,647,866 lb. in 1917 and to 16,238,533 lb. in 1918. Changsha led all the rest in the volume of copper imported in 1918 and 1919. The reason is not difficult to find. Changsha is the capital of the Province of Hunan, which has been overrun by the armies of the North and the South and is now in a bad financial condition. In 1918 the Southern troops were driven out of Changsha and the city was looted. It is now occupied by the Northern forces. Since the occupation, the mint has been coining copper. Approximately 30 tons of copper and 3 tons of zinc are melted and cast into slabs each day. The melting at the Changsha mint is done in crucibles of Japanese make for most part, although a few new English crucibles recently arrived. Approximately $800 worth of crucibles are used daily, it is said. The cast slabs are then cold-rolled on old German rolls into strips; many of which are defective, full of holes and cracks. These are then punched and stamped on small slow-working German machines which punch two blanks at a time. The dies formerly made by the Japanese are now being made at the mint by Chinese workmen. Defective coins and other scrap are re-melted in small clay crucibles made in the mint, and re-cast.

ONE-THIRD of the average man's time is spent in recreation. Every mining camp, if it desires to progress, must recognize that wholesome and health-building facilities for recreation are a necessity.

Centrifugal Pumps

By ROBERT S. LEWIS

The first centrifugal pump built in the United States was in 1818. It was called the Massachusetts pump, and was of crude design. Evidently the early pumps were not considered a success, for the wide use of centrifugal pumps has developed rapidly only during the last few years.

MECHANICS. The centrifugal pump depends for its action upon transforming the kinetic energy of a rapidly revolving mass of water into a pressure that forces the water through the pipe-line. A high velocity is imparted to the water by the action of the rotating impeller, the correct design of which practically controls the efficiency of the pump. The effect that the shape of the impeller-vanes has on the velocity of the water, as it leaves the tip of the vanes, may be understood easily by studying Fig. 1.

Let V = velocity of the water relative to the vane.

U = peripheral velocity of the vane-tip.

Then by vector addition W is the absolute velocity of the water as it leaves the impeller. The total head developed by the pump is $H = \frac{W^2}{2g} - \frac{U^2}{2g} - \frac{V^2}{2g}$, where g is the acceleration due to gravity. This total head, H, is made up of two parts: the velocity-head $\frac{W^2}{2g}$, which may be converted into pressure-head, and $\frac{U^2 - V^2}{2g}$, the pressure-head developed within the impeller. If the losses due to shock and friction be neglected, this formula holds for all pumps in which the water enters the impeller radially, and consequently applies to nearly all centrifugal pumps.

In Fig. 1 it is evident that with constant speed of rotation, U is constant, but W is the resultant of U and V. The velocity, V, of the water relative to the vane increases with the amount of water delivered. In case the impeller-tip is at right angles to the tangent at the circumference, that is, is radial, any increase in V must entail an increase in $\frac{W^2}{2g}$, but $\frac{U^2 - V^2}{2g}$ is diminished. If the vane-tip is inclined forward, the increase in W is very rapid. If we substitute for W^2 its value in terms of U and V, $V^2 + U^2 + 2VU \cos \Theta$, where Θ is the angle between the tangent and the direction of the tip of the vane, the expression for H becomes $H = \frac{U^2}{g} - \frac{VU \cos \Theta}{g}$.

As $\cos \Theta$ is positive for all values of Θ less than 90°, it is plain that for this type of impeller the greater the amount of water delivered, the greater is the head developed. When $\Theta = 90°$, cosine Θ is zero. Therefore the head is constant for all deliveries and is equal to $\frac{U^2}{g}$. For backward-directed vanes Θ is greater than 90° and $\cos \Theta$ is negative; consequently the head developed decreases as the delivery increases. A graphic representation of these different conditions is shown in Fig. 2, 3, and 4.

A knowledge of these simple relations will go far toward ensuring a clear understanding of the apparently confusing behavior of different centrifugal pumps, and it emphasizes the fact that a centrifugal pump should be designed for the particular work it is to do. The efficiency of a well designed pump may be considerably

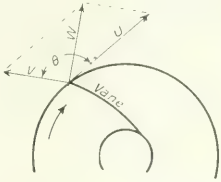


Fig 1

Fig 2

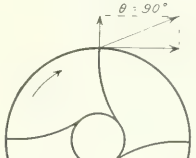


Fig 3

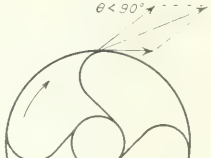


Fig 4

diminished by using the pump under conditions different from those for which it was intended.

Before a centrifugal pump can be properly adapted to its work it is first necessary to know how the capacity varies when the pump is operated at constant speed against different heads. The curve obtained by plotting the capacity or pump-discharge against the head is called the pump-characteristic. Fig. 5, 6, and 7 show the characteristics and efficiencies of the impellers illustrated in Fig. 2, 3, and 4 respectively. The efficiencies are taken from the same scale as the heads, but the figures are to be read as percentages. Brake horse-power curves are also given, but these curves are merely to show the general behavior of different pumps and not all are placed in exact position on the charts. The flatter the efficiency-curve at its highest part, the wider is the range of capacity without serious loss in efficiency. It is evident that the pump of Fig. 5 can maintain a high efficiency for a fairly large variation in discharge, but the pumps of Fig. 6 and 7 must be operated with nearly the discharge

for which they are designed in order to secure maximum efficiency. For a rising characteristic the delivery increases with increase of head and, consequently, the power required for driving the pump must increase. The more drooping the characteristic, the less will be the power required for increased delivery. Centrifugal pumps should be designed so that power-demand falls off sharply after the point of maximum efficiency is reached. Such a design makes it impossible to overload the pump-motor. A poorly designed pump might have a power-curve as shown by the dotted curve in Fig. 5. A break in the pipe-line near the pump would reduce the head nearly to zero, the discharge would be increased, and the increased power required might overload the motor so seriously as to burn it out.

In a centrifugal pump the maximum energy is possessed by the water at the instant it leaves the impeller-vane. Part of this energy is in the form of pressure-head and is $\frac{U^2 - V^2}{2g}$. The remainder is kinetic energy or velocity-head and is $\frac{W^2}{2g}$. The ratio between these two quantities depends upon the shape of the impeller-vane and also upon the relation between the velocity, V, of the water relative to the impeller, and upon the peripheral speed, U, of the impeller. In general, the velocity of the water in a radial direction as it leaves the impeller is from 10 to 15% of the peripheral velocity.

The efficiency of the pump as a whole depends upon the efficiency with which the impeller-pressure $\frac{U^2 - V^2}{2g}$ is generated and the efficiency with which the velocity-head $\frac{W^2}{2g}$, possessed by the water as it leaves the impeller, is converted into pressure. Efficiency within the impeller is secured by correct surfaces, curves of large radius, and smooth finish. It is desirable to develop as much head as possible within the impeller, because the greater the velocity-head of the water as it leaves the impeller, the more unsuitable is the form of the head-characteristic curve.

With an impeller of constant diameter the following relations hold:

The discharge of the pump varies as the speed of the impeller.

The head developed varies as the square of the speed.

The power required varies as the cube of the speed.

If the speed is the same, impellers of different diameters have these relations:

The discharge varies as the diameter of the impeller.

The head developed varies as the square of the diameter of the impeller.

The power required varies as the cube of the diameter of the impeller.

The equation for the total head against which the pump must deliver is

$$H = h_s + h_f + h_v$$

where h_s = the static head or lift in feet

h_f = the friction-head in feet

and h_v = the velocity-head in feet, or the head required to give the water the velocity it has in the pipe, and is $\frac{v^2}{2g}$ where v = velocity in feet per second

For long pipes the friction-head is usually the largest part of the total head. The friction-loss in pipes varies approximately as the square of the velocity, so the importance of keeping the velocity down to a reasonable figure is evident. The question of the make-up of the total head against which a centrifugal pump must work has an important bearing on the performance of the

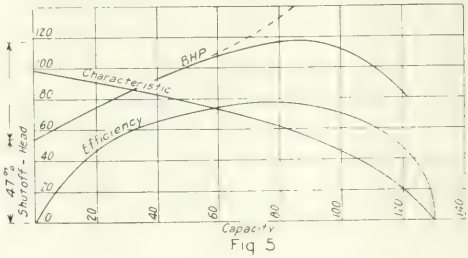


Fig 5

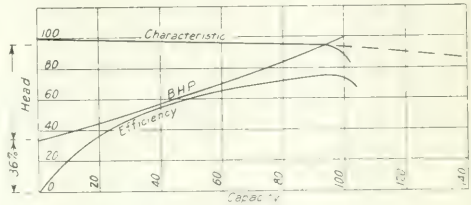


Fig 6

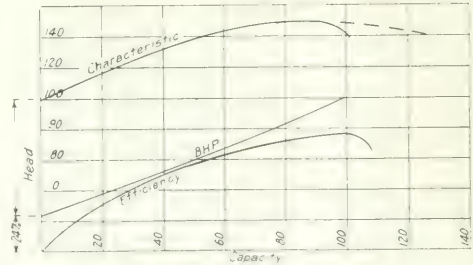


Fig. 7

pump, that is, whether the head is all static, part static and part friction, or practically all friction-head.

The volume delivered by a centrifugal pump increases directly as the speed, but the head developed increases as the square of the speed. If the head pumped against is entirely a friction-head, its value varies as the square of the velocity of the water in the pipe. The velocity varies with the delivery, hence the head must vary with the square of the delivery. Under these conditions practically constant efficiency is secured for all deliveries and at all speeds.

Should the head be partly static and partly frictional the efficiency would vary with the delivery and the pump should be designed to give maximum efficiency at one definite head and delivery. If the curve is flat, the effi-

ciency will not change greatly with moderate variations in head and delivery.

These points may be made clear by explaining the method of testing a pump to determine all its characteristics and to learn whether it fulfills the guarantee of its maker. The details of testing will be considered later, but the general factors involved will now be considered.

The pump is operated at constant speed. First, it is primed and started with the discharge-valve wide open, and the following data are noted or calculated:

Discharge in gallons per minute
Total head developed in feet
Efficiency of the pump
Brake horse-power
Revolutions per minute

The discharge-valve is closed slightly and a second set of readings is taken. Then the valve is closed farther and readings are again taken. This method is continued until the last set of readings is taken with the valve tightly closed. This point is called the 'shut-off', and is important in the selection of a motor for driving the pump. Table I shows the data derived from a test on an eight-inch pump.

Gallons per minute	Head, feet	Efficiency, %	Brake horse power	Revolutions per minute
0	111.0	0.0	28.0	1420
400	114.0	30.0	38.0	1420
800	114.0	52.0	44.5	1420
1200	110.5	65.5	51.0	1420
1600	102.0	72.5	56.5	1420
1800	95.0	73.2	58.5	1420
2000	86.0	72.5	60.0	1420
2200	76.5	70.0	61.0	1420

These results are plotted in Fig. 8. The highest point on the head-curve is 114 ft. Therefore, the pump will not deliver against a greater head. The maximum that the pump will deliver is about 2400 g.p.m., but, as will be observed on the chart, the head at this capacity would be zero. With the discharge-valve closed, the usual condition when starting a centrifugal pump, the shut-off horse-power is 28 and the head developed is 111 ft. The highest efficiency, 73.2%, is reached at a head of 95 ft. At this point the discharge is 1800 g.p.m. and 58.5 hp. is required. This is the service for which the pump is designed. However, the efficiency-curve is rather flat near this point, so that changing the head (with a corresponding change in delivery) through a moderate range would reduce the efficiency but little.

The static head against which the pump works is 80 ft. as marked by the horizontal line on the chart. The friction-head, which varies approximately as the square of the velocity of flow, or as the square of delivery in gallons per minute, is shown by the curved dotted line. The friction-head curve is so placed that any point on it gives the total head on the head-scale. Of course these two lines are independent of any characteristic of the pump. For this reason the point of intersection of the head-characteristic and friction-head curves gives the limit of capacity of the pump, approximately 1950 g.p.m., unless the head is reduced to zero, in which case the discharge will be 2400 gallons per minute.

If the pump is to be used for a lower head than that for which it was designed, care should be taken that the motor is not subjected to an excessive overload. At the point of maximum efficiency the required horse-power is 58.5. The maximum load that could be thrown on the motor is 61 hp. at zero-head. There is no danger of a serious overload here. But suppose that the pump was to discharge 600 g.p.m. The head would then be about 114 ft. and the brake horse-power about 40. The efficiency would be too low for real working conditions, but this serves as an illustration. Let a 40-hp. motor be used to drive the pump. Should the pipe break close to the pump and the head be reduced to zero, the discharge would increase to 2400 g.p.m. and the power required would be 61 hp. This would mean a 53% overload on

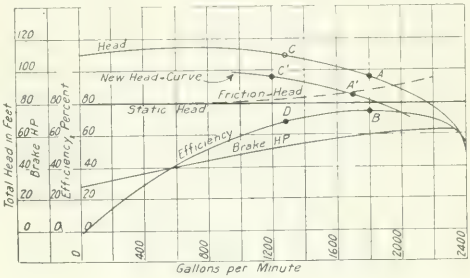


Fig. 8

the motor, which, if continued, would probably burn it out. The importance of using a pump under the conditions for which it was designed is apparent.

The effect of reducing the capacity of a centrifugal pump by throttling will now be discussed. In Fig. 8 the conditions of maximum efficiency are: discharge, 1800 g.p.m.; head, 95 ft.; brake horse-power, 58.5; and efficiency, 73.2%. If the capacity is reduced by throttling to 1200 g. p. m. what will be the result, considering the head as all static? From the data of the test the pump, when throttled to 1200 g.p.m., will develop a head of 110.5 ft., will use 51 hp., and will have an efficiency of 65.5%. However, this is not the useful efficiency as will now be shown. The useful or actual head remains constant at 95 ft., consequently throttling has developed an artificial head of $110.5 - 95 = 15.5$ ft., as a result of the friction of the water passing the throttling-valve. The power to lift the water is $\frac{1200 \times 95}{3960} = 28.8$ hp., but the pump requires 51 hp. Therefore the useful efficiency is $28.5 \div 51 = 56.5\%$ instead of 65.5%. Throttling produces an artificial head and its effect on the useful efficiency of the pump should be understood to avoid mistakes in operation. It is true that throttling also reduces the power required, in this example from 58.5 to 51, but the useful efficiency is not 65.5% as it would be if the pump were discharging 1200 g.p.m. against a total static head of 110.5 ft. with no throttling.

Suppose the original head of 95 ft. to be made up as follows: static head 50 ft. and friction-head 45 ft. The new capacity is to be 1200 g.p.m. as before. The friction-head varies approximately as the square of the veloc-

ity, and so may be taken as varying with the square of the capacity since the velocity is directly proportional to the capacity. The new friction-head developed by throttling is, therefore, $\frac{1200^2}{1800^2} \times 45 = 20$ ft., and the new total head is $50 + 20 = 70$ ft. The wasted head is $110.5 - 70 = 40.5$ ft. The water horse-power is $\frac{1200 \times 70}{3960} = 21.2$, but 51 hp. is required to operate the pump. The useful efficiency is $21.2 \div 51 = 41.6\%$. This makes it plain that more efficient results are obtained when the head is nearly all static than when it is largely friction-head. Throttling may be used where the capacity is to be reduced, but the speed of the driving motor cannot be changed. A permanent reduction in capacity is more efficiently obtained by reducing the speed of the pump, provided the new speed is suited to the prime mover.

Let it be required to reduce the capacity of the pump, under the original conditions, from 1800 g.p.m., to 1200 g.p.m. by changing the speed. The problem is one of constructing a new set of curves from the old ones with the aid of the relations between speed, power, head, and capacity. In Fig. 8 determine the point C' corresponding to 1200-g.p.m. discharge and 95-ft. head. This is a point on the new head-curve. Draw the curve through this point parallel to the old head-curve. To determine the new speed the cut-and-try method must be used until a point is found that falls on the new curve. Assume 1338 r.p.m. as the speed. The corresponding new capacity and head are found as follows: New capacity is proportional to the speed, so $1800 \frac{1338}{1420} = 1695$ g.p.m., the new capacity. New head is proportional to the square of the speed, so $95 \frac{1338^2}{1420^2} = 84.3$ ft., the new head. This point, A', falls approximately on the new head-curve, consequently 1338 r.p.m. should give the desired discharge, 1200 g.p.m. A number of such calculations are usually necessary before a point is found that will fall on the curve.

A new efficiency-curve may be drawn to be used in connection with the new head-curve. Thus, points on the original head-curve are selected and transformed into points on the new one by using the two speeds as in the problem just solved. The efficiencies corresponding to the points on the original curve are transposed to a new efficiency-curve by placing these respective values under the corresponding points on the new head-curve and then connecting them. In Fig. 8, A on the old head-curve becomes A' on the new. B is the efficiency under A, so this value is placed under A' and is a point on the new efficiency-curve. As an alternative method, the point C', through which the new head-curve was started, can be transformed into a point on the original head-curve. As C' corresponds to 1200-g.p.m. discharge and 95-ft. head, the new capacity would be $1200 \frac{1420}{1338} = 1273$ g.p.m., and the new head would be $95 \frac{1420^2}{1338^2} = 107.0+$ ft. This gives the point C', which should fall on the original head-curve. The efficiency, D, for this point is also the efficiency under C' on the new curve. The value is approximately 68%.

The brake horse-power for the point C' is $\frac{1200 \times 95}{3960 \times 0.68} = 42.4$ hp. By making similar calculations for other points a new horse-power curve can be constructed. Since the brake horse-power for the throttled discharge of 1200 g.p.m. was 51, and the corresponding efficiency was 56.5%, there is a gain, both in power used and in efficiency, by reducing the speed instead of throttling the discharge, provided this lower speed can be efficiently supplied by the prime mover operating the pump.

Testing Centrifugal Pumps. All large manufacturers of centrifugal pumps have their own testing laboratories, and each pump must be tested to determine its characteristics and to learn whether it answers specifications. Centrifugal pumps should be purchased under a guarantee, the substance of which is often as follows: "The efficiency of the pump under specified conditions of head, capacity, and speed shall be clearly and definitely guaranteed. The pump-builder shall conduct a test to determine head-capacity, efficiency, and brake horse-power characteristic curves, and a certified copy of this test is to be furnished to purchaser".

The three points to be noted during a test are, total head against which pump works, discharge in gallons per minute, and power-input. The power-input is determined by using a driving-motor which has been carefully calibrated, and whose efficiency is accurately known under all conditions of operation. The total head is determined by gauges placed in both suction and discharge-pipes. The discharge is measured by a weir, a calibrated nozzle, a Pitot tube, or by a Venturi meter.

Measurement of Head. A vacuum-gauge, or mercury manometer, is placed in the suction-pipe about two inches from the pump-flange. A pressure-gauge, or mercury manometer, is placed at a similar point in the discharge-pipe. The mercury manometer is sometimes used up to pressures of 70 lb. per square inch, though a pressure-gauge is more common. The suction-gauge is usually a mercury manometer. Pressure in pounds on the gauge is reduced to head in feet by multiplying by 2.31. Inches of mercury is converted into head in feet by multiplying by 1.132. When used thus, the pressure-gauge shows the static, friction, and velocity-heads in the discharge-pipe and the suction-gauge gives the static lift, friction-head, and head-loss due to entrance velocity in the suction-pipe. The suction and pressure-heads should be reduced to the axis of the pump-shaft as a basis for computation. In Fig. 9, D is the distance between the gauges, and should be added to the sum of the heads just found. Thus, if the pressure-gauge indicates 40 lb. per sq. in., the suction-gauge reads 20 in., and D is two feet, the total head will be $40 \times 2.31 + 20 \times 1.132 + 2 = 117.04$ ft. In case the suction and discharge-pipes are not of the same diameter, a correction must be made for the difference in velocity in the two pipes. If the discharge-pipe is smaller, the velocity in it is greater than in the suction-pipe and the pump should be credited with

the difference. If the discharge-pipe is larger than the suction, the pump should be debited with the difference calculated in terms of velocity-head. Thus if the velocity-head in the discharge-pipe is 2.5 ft. and in the suction-pipe 1.5 ft. per second, the difference should be added to the head as determined above; consequently the total head would be $117.04 + 1 = 118.04$ ft. The velocity-head is $V^2 \div 2g$, where V is the velocity in feet per second. In a centrifugal pump the water must have high velocity through the casing to obtain high efficiency so that the size of the opening of a properly designed pump is not always the best size for the discharge-pipe. The friction-head developed by the flow of water through the pipe, bends, and valves is the governing factor in selecting the proper size of pipe. To prevent excessive friction-loss the velocity in the pipe is often limited to from 6 to 8 ft. per second.

Measurement of Discharge. The rectangular weir is used for large flows of water, but the V-notch weir is

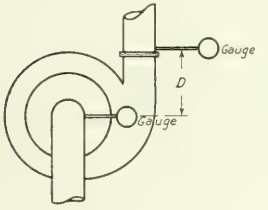


Fig 9

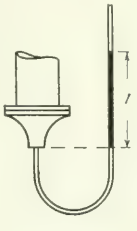


Fig 10

Fig. 11

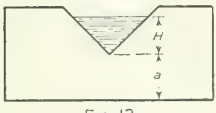


Fig. 12

more suitable for small quantities. For a rectangular weir with end-contractions, the formula of Hamilton Smith Jr. is as satisfactory as any.

$$Q = C\ 2/3\ \sqrt{2g}\ L\ H^{3/2}$$

where Q = cubic feet per second
L = length of weir in feet
H = head in feet
C = constant (see table below)

Table Showing Values of C

H in feet	Length of weir in feet						
	0.66	1	2	3	5	7	10
0.1	0.632	0.639	0.646	0.652	0.653	0.654	0.655
0.2	0.611	0.618	0.626	0.630	0.631	0.632	0.633
0.3	0.601	0.608	0.616	0.619	0.621	0.623	0.624
0.4	0.595	0.601	0.609	0.613	0.615	0.617	0.618
0.5	0.590	0.596	0.605	0.608	0.611	0.613	0.615
0.6	0.587	0.593	0.601	0.605	0.608	0.611	0.613
0.7	0.585	0.590	0.598	0.603	0.606	0.609	0.612
0.8	....	....	0.595	0.600	0.604	0.607	0.611
0.9	....	....	0.592	0.598	0.603	0.606	0.609
1.0	....	....	0.590	0.595	0.601	0.604	0.608
1.2	....	....	0.585	0.591	0.597	0.601	0.605
1.4	....	....	0.580	0.587	0.594	0.598	0.602
1.6	....	....	....	0.582	0.591	0.595	0.600

For a V-notch weir, angle 90°, the formula is

$$Q = 2.544\ H^{5/2}$$

where Q = cubic feet per second
H = head in feet

Where the rectangular weir is used the edge should be of thin iron plate, sharply beveled. The depth of the water, a in Fig. 11, should not be less than one-third the length of the weir. The height of the water on the crest, H, should be carefully measured by a hook gauge at a point several feet up-stream, where the water is quiet and its surface level. Free access of air should be allowed under the stream as it falls from the weir.

In the displacement method, the water is pumped into a tank or reservoir where the volume can be accurately measured. This is an accurate method if the rise of the water during the test is sufficient to obviate small errors in measurement.

The nozzle and Pitot-tube method of measurement is reliable if a correctly shaped nozzle is used. The nozzle should be placed at the end of a straight section of pipe to obtain a smooth jet. The velocity-head may be measured by a column of water or of mercury. If the head, I, indicated by the tube is in feet of water, the velocity of the water leaving the nozzle in feet per second is obtained from the equation $V = \sqrt{2gI}$. If the diameter of the nozzle is d inches the theoretical flow through the nozzle in gallons per minute is $19.63\ d^2\ \sqrt{I}$. The actual flow through a well designed nozzle is from 98 to 99% of the theoretical flow. Fig. 10 shows the arrangement of nozzle and Pitot tube. The head produced must be measured from the level of the outlet of the nozzle.

Centrifugal pumps may be divided into two classes, low-lift and high-lift pumps. Low-lift pumps are generally of the volute type, and are designed to work against heads up to 150 ft. The pump-casing is in the form of a spiral or volute curve and serves to guide the water from the impeller into the discharge-pipe in such manner that the velocity-head is gradually converted into pressure-head. High-lift pumps are commonly known as turbine pumps. The impeller is surrounded by a circular diffuser with vanes so arranged as to offer gradually enlarging passages to the water. In this way the velocity of the water as it leaves the impeller is converted into pressure. These pumps are used for high heads. Single impellers can be made to work against a head of 350 ft., or even greater, but it is not usual to find pumps with single impellers working against more than 150 ft. High heads are obtained in multistage pumps or those which have more than one impeller. Each impeller draws its suction from the preceding one, and adds its increment of pressure so that the final pressure is attained only in the last stage. Pumps of the multistage type are made for heads as high as 250 ft. per stage, but modern mine practice indicates a tendency to keep the head per stage between 100 and 150 feet.

Theoretically there is no limit to the number of stages that may operate in one casing, but there is a practical limit that is imposed by the size of pump-shaft required. This depends upon the distance between bearings and the size of the casing. The number of stages in one casing is usually not more than four; sometimes six are used. For high heads the pump is really a combination

of two separate multistage units working in series. Thus, an eight-stage pump is made up of two four-stage pumps.

Separate centrifugal pumps, having the same capacity, may be connected in series to pump water against a head equivalent to the sum of the heads for which the pumps were designed. However, there is danger of splitting the casing of the second pump unless it is strong enough to withstand the additional pressure to which it is subjected.

Motors for Centrifugal Pumps. The present practice of manufacturers is to rate motors nearly at their maximum capacity. This means that motors cannot be operated at an appreciable overload without danger of overheating. Where centrifugal pumps are to be motor-driven it is imperative that the approximate power required by the pump be known beforehand and that the possibility of any marked change in operating conditions should be foreseen so that the motor selected will not be subjected to dangerous overloading. Conservative average efficiencies of centrifugal pumps are given in the accompanying table. These figures can be used for estimating the power requirements of pumps of good design.

Size of pump, inches	Normal rating, gallons per minute	Efficiency, single stage; head up to 150 ft., %	Efficiency, multi-stage pumps; head above 150 ft., %
2	100– 150	50	45
3	200– 350	55	50
4	400– 600	60	56
5	650– 900	65	62
6	950–1300	70	68
8	1500–1800	72	70
10	2000–3000	75	72
12	3500–4500	76	73
14	5000–6000	77	74
16		78	75

The horse-power required is found by dividing the water horse-power by the efficiency of the pump. However, the motor selected should be one having from 10 to 12% higher rating than that calculated in order to take care of wear in the pump, which reduces the efficiency, and to meet the contingency of any small unlooked-for increase in the power needed.

In general, centrifugal pumps are easily started. The starting-power required is less than full operating-power, and this has an important bearing on the type of motor that can be used since the motor need not have a high starting-torque. Centrifugal pumps are nearly always started with the discharge-valve closed. Starting conditions are, therefore, the 'shut-off' conditions as described above. The power required at 'shut-off' is found from the pump curves. In Fig. 5, 6, and 7 the starting-power is given in percentages of power required under normal operating conditions. The percentages are 47, 36, and 24 respectively. Should a motor be of such design that its starting-torque was just sufficient to start the pump of Fig. 7, 'shut-off' power being 24% of full operating-power, the motor would be unable to start the pump of Fig. 6 which requires 36% of full power for starting. In some pumps the 'shut-off' may be as much as 70% of the full operating horse-power. If a pump is started with the discharge-valve open the motor has to come up to full power at the same time that it comes up to full speed, which means that the motor must be thrown onto the line at full rating instead of at only a fraction. Some squirrel-cage motors, used under such a condition, have had their coils loosened by the heavy surges of current caused in this way. The motors that are suitable for driving centrifugal pumps are the squirrel-cage induction motor, the slip-ring induction motor, the synchronous motor and, in some cases, the direct-current motor.

The squirrel-cage motor is most commonly used for driving centrifugal pumps. Because of its simplicity, this type is used for nearly all small and medium-sized pumps. It is inherently a motor of low starting-torque and relatively large starting-current. The average squirrel-cage motor, if thrown directly on the line, takes from four to eight times normal current. Only in the case of small machines, 5 hp. and under, can the motor be thrown directly onto the line, as the rush of current resulting would cause too great fluctuations in voltage, excessive demand of current of low power-factor on the generating-station, and dangerous shocks to both pump and motor. There is a definite limit to the starting-torque that this motor can develop. The starting-torque varies from 100 to 150% of full-load torque for full voltage, and inversely as the square of the normal applied voltage. For motors of large size some form of starting-compensator is always used to reduce the starting-voltage. If this voltage is greatly reduced the starting-torque may be low. A reduction of only one-half in current would make the starting-torque one-quarter that of full-load torque. Motors of 150 hp., or even less, are generally of the slip-ring induction type. Such motors have the ability to start smoothly against a large load and draw relatively small current from the line, thus minimizing fluctuations and the danger of shocks to motor and pump.

Synchronous motors, especially of the self-starting type, are quite suitable for centrifugal-pump drives in cases where large-sized pumps are to be operated continuously over long periods. The self-starting synchronous motor has auxiliary windings imbedded in its field-poles. Bars are placed in the pole-faces and are connected by rings, so that for starting conditions resemble those of the squirrel-cage motor. When it has attained full running speed as an induction motor it must be pulled into step or synchronous speed, after which it operates as a synchronous motor. A motor of this type can have a higher starting-torque than a squirrel-cage induction motor because a high starting-torque for a squirrel-cage motor means comparatively poor efficiency at full speed. The synchronous motor drops the induction-motor characteristics as soon as it is at synchronous speed. Once up to this speed, the motor will run at constant speed independent of the voltage of the supply as long as it is within the limits of the pull-out torque. Most synchronous motors will carry an overload of 200 to 300%, and, consequently, will continue to operate a centrifugal pump at full speed although the supply-voltage should drop to a point where there would be considerable drop in speed if an induction-motor were being used. A great advantage of the synchronous motor is that it can be adjusted to give a power-factor that will have a correcting effect on a bad power-factor in the supply-line. For this reason it is well adapted to heavy

duty where fluctuations of load would ordinarily produce a low power-factor in an induction motor. However, the synchronous motor is more costly than the induction type and is not to be recommended except in large sizes, say of 150 hp. or more.

The induction and synchronous motors are essentially constant-speed motors, and the speeds are limited by the cycles used and the number of poles on the machines. If only direct current is available, or if speed-adjustment is necessary, as in the case of a centrifugal pump that must operate against different heads, the direct-current motor is useful. The motors are either of the shunt or compound-wound type, depending upon the condition of voltage in the supply-line. There is less variation in speed due to irregular voltage in a compound motor than in a shunt-wound motor. A direct-current motor will run at a lower speed when cold than when hot, because of the lesser resistance in the field-windings when they are cold. From two to six hours is usually required for the shunt-fields to attain normal operating temperature, depending upon the size and characteristics of the motor. During the time of heating the motor will operate below normal speed and the capacity of the pump will be reduced. In one case a pump did not deliver any water until the motor was up to full speed. The special field for direct-current motors for driving centrifugal pumps is city water-works, where water at constant head must be pumped in varying amounts. High pressure can be obtained for fire purposes. Direct-current motors have a high starting-torque and a more efficient method of speed-variation than either induction or synchronous motors.*

'Baking' Gold Ore

An interesting and successful method of treating the ore from the Connemara mine in Rhodesia is outlined in a communication to the Chemical, Metallurgical and Mining Society of South Africa by B. L. Gardiner. Mr. Gardiner sets forth the essential principles involved in a process which, for the sake of a better name, has been termed the 'baking process', and which consists merely in subjecting the ore to the action of heat preparatory to treatment by cyanide. It differs from the ordinary roasting process, in that the degree of temperature to which the ore is raised is much lower than that necessary for the roasting, and, further, that the presence of air or oxygen is in no way essential to its success, the application of a certain amount of heat being all that is necessary. The net result of the introduction of the baking system at the Connemara mine has been to increase the extraction from 68 to 86%, with little or no increase in the working costs. The ore belongs to the class known in Rhodesia as banded ironstone, and at present only the upper oxidized portions of the lodes are being worked, and it is only to this oxidized ore that the scheme applies. Besides the silica and iron oxides which make up the bulk of the ore, qualitative analysis shows the presence of combined water, magnesia, and sulphates. The original plant consisted of twenty 1250-lb. gravity stamps and one 5-ft. Chilean mill as crushing units, followed by sand-leaching and slime-decantation plants, the gold being recovered by amalgamation on copper plates and by precipitation on zinc shavings from the cyanide solutions. The best results were obtained by using 200-mesh screens on the mill. The average results over a period of 12 months were: 4000 to 4600 tons per month treated, 67.9% extraction. Re-treatment of the residues failed to recover further gold, and laboratory tests merely tended to show that the plant was doing all that could be expected of it. Without the addition of lime there is an excessive consumption of cyanide, and this has been attributed to the action of ferric sulphate or basic iron sulphates. The consumption of lime is high, being from 6 to 8 lb. per ton of CaO.

The tubular drier was then designed and constructed. So far only the fine, eliminated after the rock-breaker, has been subjected to baking, the balance of the ore going through the ordinary process of milling ore, amalgamating and cyaniding. The separation of the fine and coarse is done on a shaking screen provided with 1½-in. apertures. It is estimated that the fine ore passes through the drier in 30 minutes. The time of treatment in the cyanide vats averages ten days, and the total weight of solution is at least 1¼ times that of the ore treated. The consumption of lime on the baked ore amounts to 10 to 12 lb. per ton in terms of CaO. The fine ore in mass has the appearance of rather coarse gravel, some of the lumps being as large as walnuts, then grading downward. A liberal estimate of the average cost is about 1s.10d. per ton for the actual roasting, and including transport to and from the drier to about 2s.2d. per ton. The ore contains considerable proportions of hydrated oxides of iron, and when it is heated appreciable quantities of water are given off. This water, it must be understood, is not present as moisture, since it will not be driven off in a water bath at 100°C., but requires a somewhat higher temperature, and it is evident that it exists in the ore as water of combination. Mr. Gardiner concludes by saying: "As a process likely to be applicable to the generality of gold ores, baking is not likely to hold a very important place, as its success depends upon an unusual peculiarity. At the same time there may be other ores of a similar nature, and with such as these the baking process may find a beneficial application."

TWO DREDGES shipped from Alaska by the Yukon Gold .Co. have reached Siam to be used in mining tin.

*I wish to acknowledge my indebtedness to the DeLaval Steam Turbine Co. and to the Goulds Manufacturing Co. both in regard to their catalogues and to private communications. The following articles have also been used as sources of information:

'Horse-Power Requirements of Centrifugal Pumps.' T. M. Heermans, 'Power', May 20, 1919.

'Induction Motors for Driving Centrifugal Pumps.' Fraser Jeffrey, 'Power', August 26, 1919.

'Direct-Current Motors for Driving Centrifugal Pumps'. Nathan Wilkinson, 'Power', December 16, 1919.

'Synchronous Motors for Driving Centrifugal Pumps.' S. H. Mortensen, 'Power', January 20, 1920.

Lead-Smelting Practice at Port Pirie, South Australia

By GILBERT RIGG

*In the present paper I wish to offer some account of the advances in metallurgical practice which have been made at the plant of the Broken Hill Associated Smelters Proprietary, Ltd., at Port Pirie, South Australia, during the past four years. I do not propose to enter into a detailed description of the plant itself for two reasons. In the first place there is still a good deal of reconstruction in progress and to be accomplished, so that any detailed description would be out of date in a year or two, and in the second place, in general it follows the usual lines of plants carrying out the roast-sintering and blast-furnace treatment of galena concentrate, with subsequent refining of the bullion. Specific references to equipment will therefore only be made in so far as they are necessary to make clear the operating methods.

Early in 1916, it had become evident that considerable improvement both in plant and in practice had become highly desirable, and that serious experimental work on a large scale was necessary in order to provide data on which such improvements could be most economically carried out. The roasting operation was neither as thorough nor as efficient as could be wished, and this of course reflected seriously on the blast-furnace operations, which were giving a good deal of trouble. The increasing proportion of the very finely divided flotation concentrate (or slime concentrate as it is commonly called) was in part responsible for this, as at that time its treatment was not properly understood; but the roasting practice, as a whole, needed a thorough revision, as until that was set in order good results could hardly be expected. It was on this department, therefore, that our attention was first concentrated.

The lead-sulphide concentrates of Broken Hill are divided into two classes, namely, granular concentrate (from jigs and tables) and slime concentrate (from the flotation-plants). The general average composition of these two classes is as follows:

	Granular concentrate %	Slime concentrate %
Lead	63.0	57.0
Zinc	7.0	11.0
Iron / Manganese	4.7	4.3
Sulphur	14.5	18.0
Lime	1.5	1.5
Alumina	1.5	1.0
Silica	5.0	3.5

A large proportion of the slime concentrate will pass through a 200-mesh screen.

These concentrates were formerly roasted in two different ways.

According to the first method, a mixture of the two grades, with a proportion of oxidized lead ore, mainly silicate, and also limestone and ironstone, was partly roasted in Ropp reverberatory roasters, after which the partly roasted ore was transferred to Huntington-Heberlein pots and the sulphur brought down as low as possible there.

According to the second method, the mixture was passed over a Dwight-Lloyd machine, operating as a pre-roaster, and the partly roasted sinter was crushed and passed over a second Dwight-Lloyd machine, where the elimination of the sulphur was carried as far as possible, this latter machine being the counterpart of the Huntington-Heberlein pot in the first method.

The first process gave the best results, the product from the second being uniformly poor; 5% sulphur in the final sinter was quite common, and the sinter lacked strength. Its behavior in the blast-furnaces was unsatisfactory. The Ropp roasters on the other hand took up a great deal of room and the combination of these reverberatories and Huntington-Heberlein pots did not seem to offer the same scope for economy as the double treatment with the Dwight-Lloyd machines.

Finally, while the product worked better in the blast-furnaces than the Dwight-Lloyd product it was not as good as we wanted. The final results of the investigation into the double Dwight-Lloyd method showed that at the outset we have been laboring under three serious misconceptions. These were:

(1) That the sulphur that is combined with the zinc is more difficult to roast-off than that combined with the lead.

(2) That the presence of coarse pieces of flux or pre-roast sinter are necessary in the charge in order to 'open up the bed'.

(3) That the slime is intrinsically more difficult to roast than the granular concentrate.

The first of these hypotheses received a rude shock when our attempts to blast-roast pre-roasted zinc concentrate carrying 48% zinc, came to successful fruition in 1917. Some data concerning recent developments of this method are given subsequently in this paper. At that time, however, our results showed that zinc concentrate of the above zinc content, that had been pre-roasted to 9% sulphur, could be rapidly roasted on a Dwight-Lloyd machine to 1% sulphur. Under these circumstances the reluctance of a charge carrying only 3% sulphur combined with zinc to roast to below 5% sulphur clearly needed some other explanation, and the zinc excuse was dropped, although I think I am safe in saying that the majority of lead metallurgists at that time would have concurred in it. As a matter of fact, if zinc does cause trouble it is due to the rapid evolution of heat which its roasting occa-

*A paper discussed at a meeting of the Institution of Mining and Metallurgy on May 20, 1920.

sions, this causing a tendency to fuse the galena. I do not believe, however, that this is sufficient to cause appreciable trouble.

Our second fallacy, namely, that the presence of coarse ($\frac{1}{2}$ to $\frac{3}{4}$-in.) pieces of ironstone or limestone or sintered charge are necessary to render the charge on the machine pervious to the blast, met a similar fate. This also may be reckoned as a common belief, or was at that time, but as a matter of fact it is not true. The shrinkage of the finer part of the charge around these coarse pieces certainly does open fissures in the neighborhood, and allows the blast to pass, but these openings are localized and render the distribution of the blast through the charge uneven.

THE SMELTER AT PORT PIRIE

In the case of the limestone, the coarser pieces are to be found embedded in the sinter, altered only on the surface, the bulk of the piece being simply burnt to lime. These pieces slake on exposure to the air, and cause crumbling of the sinter in consequence, which is really undoing the work done during sintering to a considerable extent.

As a matter of fact the notion that the air-blast finds its way downward between the particles of a finely divided (through 40 mesh) charge is wrong. It is quite impossible to roast such a charge dry, because the spaces between adjacent grains of ore are so small that too much resistance is offered to the air passing through. The volume of air drawn through is in consequence too small to carry on the roasting operation. By damping the charge the particles cohere into larger or smaller aggregates, and by proper mixing and handling these aggregates can be obtained of such a shape and size of grain, that the air passes readily between them, and by diffusion reaches the inside of the aggregate and roasts it through.

It is quite evident that pieces of free lime in the sinter have done no work during the roasting, and in consequence are wasted, besides taking up room on the machine to no purpose. Further, the crushing of the stone was an expense, and we lacked crushing capacity, and at the same time we had at our disposal a range of sand-hills composed of limestone sand (through 40 mesh), which was cheaper to obtain than quarrying solid limestone and, of course, needed no crushing. Our experiments were therefore directed to the substitution of limestone sand for crushed limestone in the roaster-charge, and the results corresponded with what would be expected if the foregoing conclusions were true. The charges worked more evenly, and the final sinter stood up much better when exposed to the weather.

The reduction in size of the ironstone to correspond with the limestone sand was not possible. In the first place we had not the crushing equipment necessary to reduce all the ironstone to pass 40 mesh, and in the second place we were dealing with a hard ironstone, the crushing of which would probably have been more costly than the advantage to be derived warranted. With no limestone to be crushed, however, we were able to crush all the ironstone through four mesh, which gave us distinctly better results, and later a further improvement, which enabled us to eliminate ironstone altogether from the charge, finally disposed of this problem. In the meantime the following experiment indicated clearly that our coarse ironstone was only a passenger.

Crushed through 4 mesh, the ironstone yielded a product of which 70% would pass through 8 mesh. A charge made up in the ordinary way was screened on an 8-mesh screen before going to the Dwight-Lloyd machine, thus eliminating all ironstone coarser than 8 mesh, and proportionately reducing the percentage of ironstone in the charge, as all the other constituents were fine enough to pass readily through the 8-mesh screen.

This screened charge roasted just as well as the charge containing the whole of the ironstone. On the other hand it was impossible to get good results when the percentage of limestone in the charge screened through 4 mesh was brought down to the same point. The coarse ironstone was obviously therefore not paying for itself.

Just how much of the work done by these added agents is physical and how much is chemical it is hard to say. They act as cooling agents, preventing premature fusion which would lock up sulphides in the fused charge, because they dilute the sulphides which furnish the fuel, and similarly absorb some of the heat produced. They also appear to have some catalytic action which facilitates the oxidation of the sulphides. We are preparing to make a close study of the actual sequence of operations in the laboratory and try to ascertain as nearly as possible the exact part which each of the constituents plays.

Much the same line of argument holds good as regards the size of the material which has passed through the intermediate crushing between the first and second roasting on the Dwight-Lloyd machines. The foreman in charge of the machines used to hold that the better the ore was roasted (that is, the lower the sulphur content was reduced) on the pre-roasting machines, the higher the sulphur content of the final sinter. This sounded absurd, but it had nevertheless a substantial substratum of truth. The better the pre-roast the harder and more sintered the material, and hence the greater the proportion of coarse material after passing through the rolls, that is, material up to $\frac{3}{4}$-in. size. This coarse stuff upset the roasting on the final machines, and gave rise to the belief referred to above. By keeping the size of the pre-roasted material smaller than $\frac{1}{4}$ in. this difficulty may be avoided.

As regards the prejudice against slime concentrate, this depended partly on the poor results which had been obtained in the past, and partly on *a priori* considerations based on its exceedingly fine state of division. As a matter of fact, as this slime concentrate is always obtained wet, and is subsequently dried, it is usually in the form of lumps and cakes, which, if they can be brought down to a size which will enable them to roast, without disintegrating too much, so as to bring them back to fine powder, behave perfectly well on the machines.

As mentioned before, it is necessary to damp the charge, and this naturally weakens the pieces of caked slime, and helps them to disintegrate into their original fine state. If now the charge is vigorously stirred the disintegrated material works between the granules of the charge and fills up the spaces. On the other hand, if the lumps of slime are too coarse, the air cannot reach the inside.

Originally the charges were mixed and conveyed to the machines by interrupted-flight screw-conveyors, which were driven fast, and had a strong disintegrating action. These were taken out and belt-conveyors installed instead. In the meantime a set of bins had been erected for the different constituents of the charge, the bins delivering by belts to a main conveyor-belt, the different materials being therefore distributed in thin superposed layers on this belt. Provision was also made for breaking up the coarse lumps of slime. The conveyor-belt delivered into an elevator, and this in turn to belt-conveyors that distributed the charge to the feed-hoppers over the machines. These hoppers delivered to short conveyor-belts which fed the machines as described above. The damping of the charge takes place during transit from bins to machines.

This system of mixing proved quite successful. The constituents of the charge were sufficiently blended and the slime granules remained so far undisintegrated that the charge remained evenly open. A gratifying feature of this improved distribution of the charge on the machine was the evenness of the roasting mass. Blow-holes and other irregularities became more and more rare, and with this came a substantial diminution in the amount of metal lost by volatilization. In the roaster-charge there is always more or less of a roast reaction going on with production of metallic lead and a lead-sulphate fume. The more even conditions can be kept on the machine the more easy it is to control this, and consequently loss by volatilization has sunk to less than 1% of the lead on the pre-roasting machines.

The next step was the elimination of the Ropp roasters, Dwight-Lloyd machines being used to pre-roast for the Huntington-Heberlein pots. The same precautions were used in both cases, and the work correspondingly improved. At this stage, then, the roasting of the concentrate had become considerably simplified, the practice being:

(1) All concentrate pre-roasted on Dwight-Lloyd machines.

(2) All pre-roasted material crushed and the roasting finished either on another set of Dwight-Lloyd machines or in Huntington-Heberlein pots.

The following figures will serve to illustrate the practice which we had reached at this stage:

Average composition of charge to pre-roasters:

	%
Granular concentrate	49.0
Slime concentrate	18.5
Silicious ore	12.0
Limestone	6.0
Ironstone	14.5

This charge after complete roasting gave a sinter, of which the following is an average analysis:

	%
Lead	44 to 45
Zinc	5 " 6
Silica	9 " 10
Ferrous oxide	16 " 18
Manganese oxide	3 " 4
Lime	4 " 5
Sulphur	2 " 3

In many respects this sinter was satisfactory. Considering its high metallic content its sulphur was low, and it gave good results on the blast-furnaces, with no additions except a little limestone, particularly that which was finished on the Huntington-Heberlein pots. That which was finished on the Dwight-Lloyd machines was still rather weak structurally. The output per machine was good, the pre-roasting machines, which measured 21 ft. by 3 ft. 6 in. over the wind-box, dealing with 130 tons of concentrate per 24 hours.

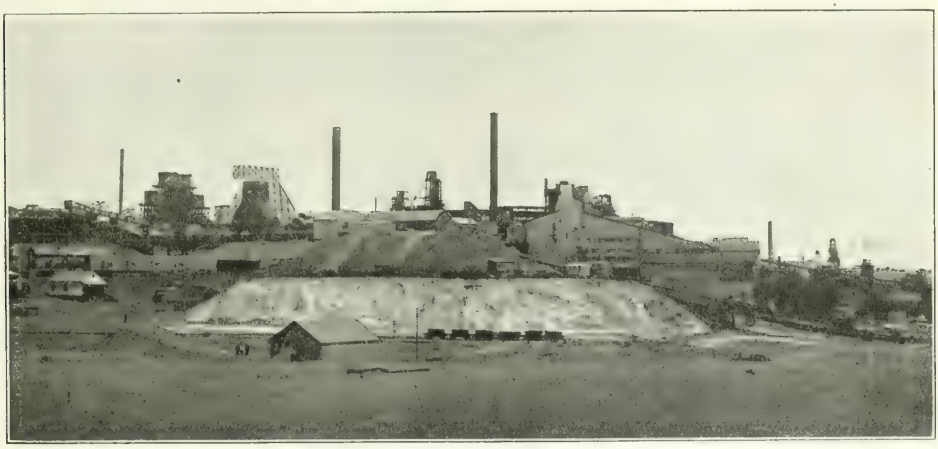
There were, however, certain unsatisfactory features. In the first place the ironstone added passed into the blast-furnace slag and became a total loss. So also did the lime and the zinc, the percentage of the latter metal in the slag being too low to render its recovery economical. Further, attempts to raise the lead content of the sinter were not successful, because it was not found possible to reduce sufficiently the percentage of sulphur in the finished sinter if the lead were seriously increased. By comparing the lead content of the sinter with that of the concentrate given above, it will be seen that the dilution is substantial. We were therefore on the lookout for some way of getting over these drawbacks, and the application of blast-furnace slag as an addition-agent in place of ironstone appeared to be worth trying.

The slag yielded by the blast-furnaces working on this class of sinter is rather a curious product so far as composition goes, as the following analysis indicates:

	%
Silica	21.0
Ferrous oxide	33.5
Manganese oxide	4.5
Lime	14.0
Zinc oxide	13.5
Lead	2.0
Silver	0.75 oz.

This highly basic mixture resisted all attempts to fit it into a formula which would satisfy any of the silicates usually postulated for lead blast-furnace slags, and the work which has been done with a view to elucidate its constitution will be described later in this paper.

From the point of view of roasting, however, here was a material carrying silica, lime, and iron-oxide, all of which we were adding to our roaster-charges. From the results obtained when trying out the different sizes of material it looked as though these substances became active when actually in a state of semi-fusion with the sulphides in the charge. Why, therefore, should not the slag act as substitute? True, the zinc content of the charge would rise owing to zinc brought into it in the slag, and this might possibly upset the blast-furnace running. On the other hand, we had become by this time pretty thoroughly convinced that zinc is only detrimental when sulphur is present in serious amount, and we looked to the slag to give us as good a roast in respect to sulphur-



THE PROPRIETARY MINE AND MILL AT BROKEN HILL

elimination as the ironstone charge. In any case, if it did not—that finished the matter. Lastly, we looked to the slag to increase the strength of the Dwight-Lloyd sinter owing to its fusibility.

Trials with crushed slag were a failure. The stuff was hard to crush and gave us coarse pieces at one end of the scale and powder at the other, neither of which was desirable. Granulating the slag by pouring it into a stream of water yielded a mass of granules, these granules being much fissured and porous, and ranging from about $\frac{1}{4}$ in. diam. down to $\frac{1}{16}$ in., the majority of the stuff being around $\frac{1}{8}$ in. With this material we soon began to get results. Encouraging results were obtained on the small scale, and finally the following charge was sent to the roasting-machines. The old charge is shown beside it for comparison:

	Slag charge, %	Old charge, %
Granulated concentrate	40.0	49.0
Slime concentrate	25.5	18.5
Silicious ore	10.0	12.0
Limestone sand	8.0	6.0
Ironstone	4.5	14.5
Granulated slag	10.0	...

This charge yielded a roasted sinter of the following composition (the old sinter is shown again for comparison):

	Granulated slag sinter, %	Old sinter, %
Lead	44.5	44.5
Zinc	7.5	5.5
Silica	11.5	9.5
Ferrous oxide	12.0	16.5
Manganese oxide	3.5	3.5
Lime	5.5	4.5
Sulphur	2.5	2.5

The sulphur content in both cases is good. The zinc has increased as was to be expected and the ferrous oxide has decreased. The blast-furnace behaved well on this sinter and we felt encouraged to go further. We accordingly changed to the following charge:

	%
Granulated concentrate	47.0
Slime concentrate	27.5
Limestone sand	7.0
Ironstone	4.0
Slag	12.5
Sand (silica)	2.0

It will be noticed that no silicious ore was used, this constituent being temporarily unavailable. The charge roasted well and gave no trouble. The analysis of the sinter showed:

Lead	47.5 to 48.5
Zinc	7.5
Silica	8.0 to 8.5
Ferrous oxide	13.0 to 14.0
Manganese oxide	3.0
Lime	5.5 to 6.0
Sulphur	2.5 to 3.0

The lead content went up without causing trouble and later we had no difficulty in carrying it as high as 50%. The blast-furnaces behaved all right, the slag showing:

	%
Silica	20.5
Ferrous oxide	30.0
Manganese oxide	4.5
Lime	12.0
Zinc oxide	19.0

Finally, the whole of the ironstone was taken off the charge. No trouble followed, and the charge became simply a mixture of ores, granulated slag, and about 7% of limestone sand. All crushing of raw materials was eliminated and the whole process simplified until a steady practice has resulted with corresponding beneficial effect on the blast-furnace operation which follows it.

Before leaving the subject of roasting, I should like to refer briefly to our more recent work on the blast-roasting of zinc concentrate. We were faced in 1917 with the urgent need of quickly increasing our zinc-concentrate roasting capacity, while anything like prompt delivery of roasting equipment was out of the question.

Blast-roasting on Dwight-Lloyd machines or Huntington-Heberlein pots of Broken Hill zinc concentrates was found to be out of the question owing to the high temperature generated and the fusibility of the ore, which caused it to melt and become impervious to the draft; and having regard to the fact that the roasted ore was to be treated in retorts no addition-agents were possible. Finally, the problem was solved by pre-roasting the ore from 30% sulphur to 9% in reverberatories, at which point the heat generated on the blast-roaster is not sufficient to cause fusion, and finishing on a Dwight-Lloyd machine. The product is a dry crumbly sinter, readily broken through a $\frac{3}{8}$-in. ring, at which size it is charged into the retorts where it works excellently, the sulphur content of the roasted ore being 1%. Recent work has shown that the capacity of a reverberatory furnace roasting our concentrate from 30% to 9% is rather more than double its capacity when roasting to 2%. Further, that, using a multiple-hearth muffled roaster, 5% of fuel is ample to bring the ore down to 9% sulphur. The blast-roaster requires not more than 1% of fuel to ignite the charge. Hence the consumption of coal by this method is reduced to a maximum of 6%. Further, an interesting relation has been established between the different factors concerned in roasting. These factors are three in number, namely:

(1) Temperature.
(2) Time.
(3) Ventilation.

By 'ventilation' I mean the maintenance of contact between the ore particles and the air. These factors are more or less interdependent. For example, by increasing the length of time a lower temperature can be used. Our more recent work has shown that the factor of ventilation is of enormous importance.

In blast-roasting the air is drawn directly through the charge, and in consequence has an excellent chance to come in contact with the ore-particles. When roasting on a hearth the air passes over the charge, and in consequence the contact between ore and air is poor, and the interstices of the ore-charge are largely filled with a mixture of sulphur di-oxide and nitrogen. This is to some extent shaken out during stirring, but as the stirring mechanism does not work in between the grains of ore the effect is incomplete. Moreover sulphur di-oxide being a dense gas has a low diffusion rate.

Consider first a furnace of the superposed-hearth type, namely, the M. & H., having two sets of hearths measuring 80 by 6 ft. The ore descends from hearth to hearth, and in general not less than the last two hearths will assist in eliminating the last 8 units of sulphur driven off. The capacity of the furnace is 40 tons of ore per 24 hours for the two sets of hearths. Consequently four hearths out of the fourteen are concerned with the elimination of the last 8 units of sulphur from 40 tons of ore. The hearths measure 60 ft. net between drop holes. Hence the total hearth area concerned in removing these 8 units from 40 tons of ore is 60 by 6 ft. by 4 = 1440 sq. ft. 8% of 40 tons = 7168 lb. sulphur. Hence amount of sulphur roasted off per square foot of hearth per day is five pounds.

The Dwight-Lloyd roaster we are using has an active grate area over the wind-box of 16 ft. by 2 ft. 6 in. = 40 sq. ft. and roasts 60 tons of ore from 9% to 1% per 24

hours. Hence the elimination of sulphur per square foot per 24 hours amounts to 270 lb. This is a remarkable result, and illustrates strikingly the tremendous importance of the ventilation factor. The ore passes over the machine in a layer from 4 to 4½ in. thick, and the time required to eliminate eight units of sulphur is 14 minutes as against 14 hours or more for the M. & H. furnace.

I feel pretty well convinced that the future of zinc-concentrate roasting lies in a combination of multiple-hearth pre-roasters and finishing blast-roasters. The blast-furnace practice has undergone an evolution parallel to that of the roasting, and for the proper understanding of it some reference to the part played by zinc in lead blast-furnace troubles is essential. About seven years ago, I was engaged in an attempt to make use of a water-jacket blast-furnace for the production of zinc-oxide from low-grade zinc-carbonate and zinc-silicate ores. In the early stages of the work, before the conditions under which the zinc could be reduced and driven off from the charge were understood, from 70 to 80% of the zinc passed into the slag, which carried as much as 32% zinc oxide. In spite of the evil reputation which zinc possessed for making slag viscous and sticky, this slag ran perfectly and gave not the slightest trouble.

Zinc is only a trouble-maker when combined with sulphur. In the ore referred to in the preceding paragraph, the sulphur content was less than 1%. But with the high-sulphur sinters, which were the rule at Port Pirie before the reform of the roasting-practice, troubles due to zinc were serious and frequent.

Briefly, the trouble caused by zinc in the presence of sulphur is the formation of a zincy matte containing about 14% of zinc. This matte is of a mushy consistence and lends itself excellently to the building up of accretions inside the furnace. There is considerable evidence that it is soluble in the slag but separates out readily if the temperature falls. For example, it forms a crust on the surface of the slag in the slag-pots, having apparently separated from solution and come to the surface. Its constitution and properties need more thorough study than they have received in the past.

The introduction of slime concentrate into the charge had increased the zinc content and at the same time, before the roasting of the slime had been properly worked out, had brought up the sulphur content of the sinter likewise. Hence conditions were well adapted for trouble in the blast-furnaces. A rather curious practice had developed. Large bodies of old slag running lower in zinc than the new slag were available on the dump. This material was quarried and charged into the furnaces. Enormous quantities were used, the old slag being from one to two times the weight of the other constituents of the charge. The furnaces were thus exposed to a tremendous flushing action by this mass of molten material passing through them, and in all probability, this slag also acted by dissolving the zincy matte produced from the high-sulphur sinter and carrying it out of the furnace.

This practice had several obvious drawbacks. In the first place the cost of quarrying was an item of expense, and the disposal of this great volume of slag was another. Then again the melting of all this slag and its elevation to the temperature of the furnace consumed a good deal of coke, and the slag took up room in the furnace that could be more profitably occupied by sinter.

On the other hand it was felt by all engaged on the work that the true solution of the problem lay in the improvement of the roasting, and that no attempt should be made to seek out remedies for the blast-furnace troubles until sinter of reasonably low-sulphur content was available. As improvement in roasting continued, the blast-furnace practice was modified until it became simplified down to its present form.

In the days of the returned-slag practice the charge was a complex one, consisting of:

Dwight-Lloyd sinter,
Huntington-Heberlein sinter,
Ironstone,
Limestone,
Refinery-drosses,
Returned slag,
Slag shells.

The last item is the slag which is frozen in the pots and forms a shell or skull. The metal in the slag tends to concentrate in these shells and they are consequently returned to the furnaces.

Since the introduction of granulated slag into the roaster-charge the blast-furnace charge has become:

Dwight-Lloyd sinter,
Huntington-Heberlein sinter,
Refinery drosses,
Slag shells.

The simplification is obvious. The furnaces are hot, run smoothly, and the slags are low in lead (1 to 2%). The surface of the slag in the pots is free from any crust of zincy matte.

In this connection it may be pointed out that the Broken Hill ores contain less than 1% copper. Where copper in oxidized form is added to the charge, its high affinity for sulphur enables it to combine with this element to form an easily fusible matte which separates readily from the slag, or, as the furnace-men say, the copper cleans the slag. Where copper is present in serious amount higher sulphur can be carried without trouble, but with our ores 2.5% sulphur in a sinter carrying 45 to 50% lead is as much as can be allowed if perfectly smooth running of the blast-furnaces is to be assured.

The slag presents some interesting problems. The following analyses show the composition of the slag when ironstone to the extent of 14% was used in the roaster-charge, and again after granulated slag had been substituted for all the ironstone.

	Ironstone, %	Granulated slag, %
Silica	21.0	24.2
Ferrous oxide	33.5	25.6
Manganese oxide	4.5	5.3
Lime	14.0	11.0
Zinc oxide	13.5	20.0

In addition we have another one made when furnaces were running on a very zincy concentrate:

	%
Silica	18.3
Ferrous oxide	20.3
Manganese oxide	4.9
Lime	9.0
Zinc oxide	31.8

The difference between the foregoing figures and 100 is accounted for by alumina 5 to 6%, lead 1 to 2%, and sulphur 2 to 3%.

The ratios of bases to silica are for the three slags respectively 2.7, 2.17, and 2.96. In the last example the zinc oxide alone is more than sufficient to form with the silica a metasilicate. A good deal of work has been done on this slag with the object of working out its constitution. This is not yet complete but the results obtained so far are of interest. Unfortunately there are no means at our disposal for ascertaining the constitution of a slag at the really interesting stage of its career, namely, while it is still in the furnace. Once safely out of the furnace its practical interest has largely departed. Still a certain amount of information can be obtained from the frozen material.

In thin slices under the microscope the slag is seen to consist of two distinct mineralogical types, namely, a clear and transparent ground-mass, with a black to brown, opaque to translucent, scattered constituent. In the former olivene (fayalite) and willemite (the orthosilicate of zinc) are present. The brown mineral has been provisionally determined as a zinc and iron-bearing spinel or ferrite. Crystals of the green zinc-alumina spinel are also present.

The evidence in favor of the presence of iron-bearing spinel is as follows: In fine powder the slag is decidedly magnetic, and if kept melted for some hours at a temperature close to its melting-point it deposits a strongly magnetic mushy material. The natural ferrite or franklinite is strongly magnetic. Its crystallization, though not very distinct, is apparently octahedral. It is well known that zinc ferrite is insoluble in dilute sulphuric acid. If the powdered slag is subjected to treatment with a substantial excess of this acid, only a part of the zinc is soluble, the remainder being retained in the dark-colored insoluble residue. Ferric oxide is present in the slag but its determination is difficult owing to the reducing action of sulphides in the slag.

In many cases the brown mineral is found in fine parallel rods in the silicate base, these rods being oriented according to the crystallization of the silicate ground mass in which they are embedded. The appearance suggests that they have been rejected from solution in the silicate at the moment of freezing. It would appear that some zinc oxide is present in solution also.

Provisionally then we regard the zinc as being distributed between the silica as a silicate and the iron as a ferrite, and that while the slag is in the furnace the latter is probably in solution in the former; and moreover that some part of the zinc is also in solution. That these components are perfectly fluid at the temperature of the furnace, the smooth operation is sufficient proof.

It is hoped that as a result of the experimental work now going on we shall eventually be able to arrive at the true constitution of the slag. There is no doubt that the whole question of slags is worthy of more investigation than it has hitherto received.

Before leaving this subject, the possibility of recovering part of the zinc in the slag needs a few words. It would appear that our slag in the future will carry about 20% of zinc oxide, if not more. I have already referred to the fact that the earlier slags were too poor in zinc to make the recovery of this metal worth while. With 20% or more of zinc oxide, the question takes on a different complexion, and I believe that a large part of this can be economically recovered, either by blast-treatment or in a reverberatory furnace.

Reference has been made, under the head of roasting, to two types of sinter, namely, that made entirely on Dwight-Lloyd machines and that made in Huntington-Heberlein pots after pre-roasting on a Dwight-Lloyd machine. Just which of these methods will finally be used, or whether both will be retained, is a question that cannot be answered yet. The Huntington-Heberlein sinter is still stronger than the Dwight-Lloyd, but less porous. The Huntington-Heberlein is more massive and stands rough-handling better. There seems to be little doubt that the blast-furnaces run better on a mixture than on Dwight-Lloyd alone, and, provided this is borne out by further testing, it is probable that both methods will be retained.

The foregoing covers the main elements in the development of our roasting and smelting practice. In general, we have moved along the line of simplification of methods, and so far as our opportunities and abilities lay have aimed to progress by way of making the best use of our existing equipment rather than by radical changes in it. In fact the great difficulty of obtaining supplies of this kind practically forced us to adopt the lines we did.

There is just one point I wish to make in this connection. New processes and new appliances usually have the advantage of the concentration of a great deal of energy and trained brains on their development, while the older methods have a tendency to degenerate into rule-of-thumb practice. One sometimes asks oneself what would happen to these older things if they were laid hold of and studied with the some zeal that is devoted to the new ones. So far as lead-smelting goes I do not think that the last word has yet been said in regard to the method of blast-roasting the ore and smelting the sinter in blast-furnaces.

THE OWNERS of asbestos mines near Paotingfu, Peking district, are seeking capital for the development of their properties. It is said that if Americans do not evince an interest the holders of the concessions will have to turn to the Japanese for assistance. The available monthly output is estimated at between 100 and 200 tons. Other deposits in the vicinity of Liangkochwang are for sale. The samples shown have a fibre of good length, of which about 30 tons monthly is available.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

COLORADO

PRODUCTION FROM CRIPPLE CREEK.

CRIPPLE CREEK.—Production during June from the Cripple Creek district totaled 38,867 tons, average assay-value $13; and gross bullion, $443,867. The Golden Cycle mill at Colorado Springs reported treatment of 18,500 tons of $20 ore with value of $370,000. The Portland company's Independence mill at Victor treated 19,667 tons of an average value of $3.64, and the total bullion amounted to $71,765. Samplers shipped 750 tons to smelters estimated at $75 per ton. The Portland Gold Mining Co. has declared the regular quarterly dividend of 1½c. per share, payable July 20 to stock of record July 13. This amounts to $45,000 and will bring the total to $11,647,080.

The Wilson lease is again shipping from the Ingham mine on Raven hill owned by the Doctor-Jack Pot Mining Co. The ore is milling grade. A new and rich ore-shoot has been opened on the 14th level of the Dexter mine on the south slope of Bull hill, on the Trail property of the United Gold Mines Co. by the leasing firm of Anderson & Benkelman. The vein, 4 to 5 ft. wide, is reported to carry rich ore. The extent of the shoot is not yet determined. Ore will be shipped from the War Eagle workings at the Moffat tunnel level, during the ensuing week. The ore will be hoisted through the Blue Flag shaft. Development at the 1200 and 1400-ft. levels of the Blue Flag continues.

Dumps at the Index mine, Gold hill, are to be worked over and screened. Ore saved will be shipped to the Golden Cycle mill. Delay has arisen in starting up the Gasche process mill of the Lincoln Mines & Reduction Co., on Ironclad hill, because of the failure of the manufacturer to ship minor parts of machinery.

IDAHO SPRINGS.—Boston owners of the French Flag, closed down when Col. Ripley, the manager, entered the coast-defense service during the War, are preparing to resume operations. The Roosevelt Mining & Milling Co. has resumed operations on its properties at Alice. The Metals Mining & Leasing Co. has installed machinery at the Big Five tunnel and is cross-cutting to cut the extension of the Comstock shoot on the Sheffer claim. The Lincoln group is under development through the Big Five tunnel by B. F. Zalinger of New York, B. F. Francis, and Denver associates. A flat vein 40 in. thick and of good ore is reported opened up on the Virginia B. on Bellevue mountain.

EMPIRE.—The Golden Empire Mining Co., that is operating the Conqueror, Union, and General Harrison, in North Empire, and the Tennessee, Denver City, and Marshall-Russell groups on Covide mountain and Miller gulch, and that controls a large group of some 200 claims in the district, will shortly commence shipments. A modern mill has been constructed and is turning out concentrate. Three other mills on the property are to be remodeled. Shipment of a good grade of ore mined by lessees from the Bellevue-Hudson is being made regularly. The leasing firm of Nelson & Co. is shipping to the Idaho Springs mill and Pueblo smelter of the American Smelting & Refining Co. from Silver Mountain properties.

CENTRAL CITY.—Denver operators have taken over the Federal mine in Russell gulch under bond and lease and are preparing to develop it. The shaft is 400 ft. deep and produced rich ore when last operated. Water in the Coaley shaft in Silver gulch has been lowered several hundred feet. The shaft is 800 ft. deep and through long inactivity is in such condition that it must be re-timbered. The mine, now operated by the O. C. Reddick company, was one of the first silver producers in Gilpin county.

MONTANA

BUTTE AND PLUTUS SHAFT CUTS WIDE VEIN OF SILVER ORE.

BUTTE.—Six feet of silver ore has been cut by the Butte & Plutus company while sinking its shaft. The discovery was made 250 ft. from the surface and is believed to be the Plutus main vein. Exploration of this vein will be continued from the 300-ft. level. When the shaft reaches the 400-ft. level, a cross-cut will be run toward the Norwich claim to intersect the south-dipping Norwich vein. The orebody consists of silver sulphide with a pink manganese gangue.

COOKE CITY.—A fleet of twenty 2½-ton trucks is being used to haul the ore from this district to Gardner for shipment by rail. A temporary loading-station has been constructed until permanent ore-bins are built. The Republic mines expect to ship 50 tons per day by truck. W. E. Renshaw has charge of the development work for the Republic interests.

NEIHART.—W. D. Murphy and H. Westgard have leased the Rochester mine from the Cascade Silver Mines & Mills Co. for a period of six months. A steam-plant, compressor, and other machinery have been installed to speed-up development work. A promising vein has been uncovered.

The Flohart Silver mines, which were closed down on account of the O. B. U. strike for four weeks, resumed

operations for one day, only to close down again the following day. The men had agreed to accept the terms of the management, but the agitators succeeded in persuading them not to. The scale agreed to was as follows: Blacksmiths, $6.50; compressor-men, $5.75; blacksmith helpers, $5.50; machine-men, $5.50; carpenters, $5.50; shovelers, $5; and laborers, $5. The O. B. U. was not to be recognized, and there was to be no discrimination.

BOULDER.—High-grade copper ore has been found at the Shields and Ironside mine at a depth of 800 ft. The ore assays $42 per ton across the face of the vein. M. L. Leydig of Helena holds the property under lease and bond.

NEVADA

LOW-GRADE VEINS AT QUARTZ MOUNTAIN ARE TO BE DEVELOPED.

QUARTZ MOUNTAIN.—The Goldfield-Quartz Mountain Mining Corporation has been organized to develop the Bell group of eight gold claims at Quartz mountain, 12 miles west of Goldfield. The purchase price is said to have been between $10,000 and $15,000. The company was financed in Los Angeles and all of the officers are Los Angeles men. Corrin Barnes of Goldfield is consulting engineer. Air-drills will be used to extend a 160-ft. tunnel 65 ft. to cut the vein at a depth of 140 ft. The vein is 110 ft. wide, consisting of four bands: A 20-ft. width of iron-stained porous quartz; 40 ft. of pumiceous material; 30 ft. of hard dense quartz; and 20 ft. of iron-stained material. The ore is in the iron-stained and pumiceous bands, but pannings can be secured over the entire width of the vein. The following assays were secured: An 8-ft. width, $8; 18 ft., $17; 24 ft., $5.20. The gold, yellow and high-grade, is in flakes embedded in quartz. The vein follows the general course of the fissuring in the district. The outcrop is 1500 ft. long, conforming to the curvature of the hill known as Quartz mountain, and the silicification becomes less intense from the top of the hill, the vein being composed of softer rock where it disappears under the wash of the slopes. Mr. Barnes says the surrounding formation is dacite and that the hill is "an effusive mass of material similar to the dacite and erupted at a slightly later time". He says it probably is allied to the dacite vitrophyre of Ransome's report on the Goldfield district. Some of the fissures are large and show the result of displacement. Some are completely filled with quartz and others are open, forming crevices.

TULE CANYON.—A contract has been let to sink 100 ft., from the present depth of 150, the Silver Hills shaft in Tule canyon. The Silver Hills is operating the Ingalls mine under option. The company will pay $20 per foot and furnish power.

STONEWALL.—The Yellow Tiger, which is driving a tunnel at Stonewall mountain, near Goldfield, has levied assessment No. 2, at the rate of one cent per share, payable immediately and delinquent August 7. The company collected $25,400 by assessment No. 1, levied December 8, 1919, and to June 15, $20,450 was spent, leaving a balance of nearly $5000. There was spent for the erection of buildings at the mine, for road-construction and machinery $8300; a $3000 payment was made on the Red Lion claims at Goldfield; office, corporation, and administration expense was $2600, and labor and supplies cost $2400. The clearing of old accounts, prospecting at Goldfield, and the purchase of equipment for the tunnel and a motor-truck made the expenses heavy.

MONTEZUMA.—The Harmill has completed several buildings on the Monitor claims and has built a road to the shaft. A new hoist-house has been built and a 15-hp. hoist is to be moved from Divide, which has become a good field for the purchase of second-hand machinery, as Goldfield long has been for houses. During the height of the Divide boom there was never a day for months that there was not a house on the road from Goldfield to Divide and now all of them, except those at the Tonopah Divide and a few other places, have little more value than the claims on which they stand.

TONOPAH.—The Tonopah Extension has moved 10 houses from Goldfield and has furnished them with modern conveniences. They will be rented to employees at a low rate in an effort to solve the miner-shortage problem, which has become acute in some southern Nevada districts. The labor turn-over in the smaller districts is heavy and the shortage of good miners is felt keenly. An engineer in charge of a dozen prospects in southern districts complains that he cannot secure good miners and says his experience in the last year leads him to believe the 'mucker' is entering the class of the dodo.

JUNGO.—Three leases have been let by the newly organized Pershing Lead-Silver Mines Co. on the claims owned by the company at Jungo, in Pershing county, three miles from Antelope on the Western Pacific railroad. The Pershing Lead-Silver is sinking a shaft, now 40 ft. deep, in ore from a few inches to three feet wide and assaying $35 to $40 in lead, silver, and gold. Jungo is one of several districts in or near the Jackson range that have attracted attention in recent months. The Mandalay is sinking a shaft in silver-gold ore near the Pershing Lead-Silver. Work on a small scale for many years in the Jackson range has resulted in promising copper, gold, silver, and lead prospects, but important mines have not resulted. Several carloads of high-grade silver-sulphide ore have been shipped from the Mandalay and small shipments of rich silver ore have been made from the Duffner, 15 miles north of Jungo. Twenty miles from Jungo, at the southern end of the Jackson range, the Craven company has shipped high-grade copper ore and has concentrating ore blocked out to a depth of 200 feet.

GOLDFIELD.—The Silver Pick has started shipping to the Development mill at a rate of 25 tons of $15 to $18 ore daily. The shipments are being made from the 117-ft. level. The cross-cut at a depth of 271 ft. will have to be driven 80 ft. more to cut the same vein. All of this work is being done in ground sub-leased from the Development company.

TOLICHA.—A 10-ton pan-amalgamation plant has been

started at Tolicha to test ore from the Landmark claims, being developed by Thomas Harney of Chicago and associates. Two of four wide veins 5 to 20 ft. wide have been cut and the value and width of the ore, as reported unofficially, indicates that a mine of much possibility is being developed. A tunnel is being driven and a 10-ft. width of ore assaying more than $100 is reported in the first vein cut. A 3½-ft. width is said to assay more than $500. Mr. Harney, who makes his headquarters in Goldfield, has consistently refused to make a statement regarding the mine until further work has been done.

UTAH

DIVIDENDS OF UTAH MINING COMPANIES.

SALT LAKE CITY. In spite of unfavorable conditions, the metal mines of Utah showed a gain in the amount of dividend disbursements for the first six months of the current year, as compared with the same period for 1919, amounting to $120,083. During the first half of 1919 the Bingham Mines Co. and the Ontario Silver company paid dividends, whereas so far this year they have paid none. The Daly-West, of Park City, has been added to the list of dividend-payers this year, after a period of seven years. The following table shows the disbursements for the first half of 1920 and 1919:

	First half of 1920	First half of 1919
Bingham Mines Co. (Bingham)	$	$75,000
Chief. Con. Mining Co. (Tintic)	176,846	169,004
Daly Mining Co. (Park City)	45,000	52,000
Daly-West (Park City)	100,000	.....
Eagle & Blue Bell (Tintic)	89,314	44,657
Grand Central Mining Co. (Tintic)	42,000	24,000
Iron Blossom Mining Co. (Tintic)	25,000	25,000
Judge M. & S. Co. (Park City)	120,000	60,000
Ontario Silver (Park City)	.....	75,000
Tintic Standard (Tintic)	234,540	187,952
Utah Copper Co. (Bingham)	4,873,470	4,873,470
Total	$5,706,171	$5,586,083

In addition to this, the American Smelting & Refining Co. and the United States Smelting, Refining & Mining Co., both with extensive interests in the State, have paid dividends, part of which were earned in Utah.

EUREKA.—In spite of the railway embargoes, lack of miners, and unfavorable conditions that have prevailed at various times during the first six months of 1920, ore shipments from the Tintic district during that period totalled 3537 cars, as against 3632 for the same period in 1919, or a decrease of but 95 cars. Mining in this district was started in 1870, or exactly a half-century ago. The camp has been a steady producer during all this period, and shipments today are at the rate of about 600 cars per month. So far this year, five new shippers have been added to the list of producers. Ore shipments from the camp for the week ended July 3 totalled 148 cars, or one less than for the previous week.

Directors of the Chief Consolidated have declared a dividend of 10c. per share, payable August 2 to stockholders of record July 10. This payment, the second quarterly for the current year, will call for $88,423 and will bring the grand total dividend disbursements by the company up to $1,783,094. A new co-operative leasing system is being tried out by the company. Stopes of liberal size are turned over to a group of miners on a royalty basis, which ensures the company about the same amount of money that could be realized under the old system of 'company time' work, and at the same time gives the men employed a chance for a greater return for their labor. In a few places this plan is being tried out below the water-level, where three shifts are required, and this means that as many as ten or twelve miners share in the revenue derived from a single block of

NEVADA CON. PIT, COPPER FLAT, NEAR RUTH

ground. The regulations governing this system of leasing require that every miner who works on the block be interested, and when the work of any man becomes unsatisfactory, his partners in the lease have the right to vote him out and take in another miner. As the lessees have not been to any expense in searching out the ore, or in putting it in shape for extraction, the company's royalty charges are necessarily larger than usual, but even so, there is more money to be made by the lessees as extra compensation for efficient work, over and above regular daily wages.

The Tintic Standard company shipped 100 carloads of ore in June, and this amount could be easily increased if men were available. The mine could use at least 100 more men. A part of the present output is from the deepest level (1450 ft.) where a large deposit was opened recently. In the south end of the property, three headings are

being driven, two on the 1200-ft. level and one on the 1000. One of the drifts on the 1200 is being sent over toward the big stopes, principally to help ventilation, although it should encounter ore. About 1200 ft. of work remains before the connection is made. E. J. Raddatz, president of the company, states that the claims of the South Lily Co. have recently been purchased by the Tintic Standard. The South Lily adjoins the Tintic Standard on the south. Excellent progress is being made on the new milling plant, and it is expected that the first unit will be ready for operation by fall.

Park City.—Shipments for the first six months of 1920 were about 50% larger than for the corresponding period of 1919, being 52,443 tons as against 35,368 tons. The high price of silver during the early part of the current year stimulated mining considerably, which accounts for the increased production.

The Judge M. & S. Co. will open a company store that will be ready for business on August 1. The store will be conducted solely for the benefit of the employees of the Judge company and all other properties under the same management. All goods will be sold on the cost system. Coupon books will be issued to the employees, and if unused coupons are in possession of employees when connection is severed with the company, they will be redeemed at full value. The store will be open every afternoon and goods delivered once each week, purchasers paying pro-rata the expense of delivery.

An important strike of high-grade ore was made recently in a cross-cut on the 700-ft. level at the Naildriver property, according to J. D. Fisher, superintendent. The ore has been developed to a width of three feet, and assays run as high as 150 oz. silver per ton. Shipments have been started, and should average 200 tons per week during the present summer. Frank Fleishman, superintendent of the Ontario, states that development work at that property was suspended for a week on account of the compressor breaking down. Operations were resumed on July 6. At the Silver King Coalition property, 190 men are now on the payroll and at least 100 more could be used to advantage. Physical conditions at this property are excellent, and development work in new territory is reported as highly satisfactory.

WISCONSIN

ZINC AND LEAD MINING DURING JUNE.

Notwithstanding the fact that offerings for zinc ore remained low and that the price for lead ore had dropped considerably, the Wisconsin districts maintained uninterrupted operation all through the month of June, and good production resulted. High-grade zinc ore recovered at magnetic separating-plants was in good demand at the beginning of the month, on a range of prices running from $48 to $51 per ton. Premium-grade ore commanded even higher figures, but a recession in price came the second week, the base holding flat at $48.50 per ton. At the close of the month, the base price for refinery blende stood at $49 per ton, and while complaint was general that the price was not high enough to warrant profit-taking operators held their working-forces together hoping for an upward turn. Low-grade zinc-ore producers received better offerings during the month and a considerable portion of reserve ore was sold but lean producers found it hard going and several mines were shut-down pending better market conditions. The mines in the Highland district operated by the New Jersey Zinc Co., were all shut-down and over 100 men thrown out of employment. Many quickly transferred to other parts of the field. The Blewett mine, in the Galena district, shut-down and several producers in the Livingston district gave up all hope of continuing production, assigning as the reason low prices for zinc concentrate.

Lead ore, which had reached $110 per ton prior to June, dropped at the beginning of the month to $100. This figure was destined to remain but a short time and the price current over the better part of the month ruled around $90. Many producers who had refused $110 for their ore, believing even better prices would prevail, held on after the drop calculating the price would recover but, when less than $100 was offered, a portion of the holdings was sold. The increased output of zinc ore aided materially in an increased production of lead ore and the reserve in the field closely estimated at the close of the month, is in excess of 1000 tons. No competition was noticeable between buyers as had been the rule when lead ore ruled high and the major portion of lead ore sold through June went to the Federal Lead Co. Scores of lessees gophering old workings on a small scale met with poor success and sales of mixed lots for the month were negligible. The bulk of the lead ore recovered in the Wisconsin field will come in the future from the big zinc-mine operators.

Producers of carbonate-zinc ore, in the northern districts of the field, shut-down permanently. Prices for this class of ore have been steady and fair but the big deposits have been mined out and unless new exploration work determines new ranges in virgin soil this portion of the field will be abandoned.

Deliveries of zinc ore and lead for June, by districts, follow:

Districts	Zinc, lb.	Lead, lb.
Benton	10,360,000	440,000
Cuba City	4,600,000	62,000
Livingston	5,492,000	80,000
Galena	3,558,000	160,000
Day Siding	814,000	80,000
Highland	760,000	.....
Hazel Green	806,000	.....
Platteville	716,000	.....
Shullsburg	664,000	90,000
Linden	336,000	.....
Millbrig	132,000	.....
Total	28,238,000	912,000

The gross recovery of crude concentrate for the month at mills amounted to 13,949 tons. A small surplus of crude ore was disposed of during June but the reserve in the field at the close of the month ran up near 10,000 tons, most of which was held at refineries and by one or two of the larger operating concerns.

Shipments of high-grade blende from separating-plants were made for the month as shown here.

Company	Lb.
Mineral Point Zinc Co.	5,670,000
National Ore Separators	2,966,000
Wisconsin Zinc Roasters	1,266,000
Block-House Mining Co.	540,000
Zinc Concentrating Co.	532,000
Total	10,974,000

The total net deliveries of high-grade zinc ore from the field to smelters for June amounted to 5487 tons of blende, and 440 tons of carbonate-zinc ore.

Raw-ore production was distributed as follows: to the Mineral Point Zinc Co., 5487 tons; Wisconsin Zinc Roasters, 5360 tons; National Ore Separators, 2147 tons; Zinc Concentrating Co., 685 tons. High-grade ore was divided mainly between the Prime Western Smelters, a subsidiary of the New Jersey Zinc Co., Depue, Illinois, and the Mineral Point Zinc Co., so that practically all went one way for the month. It indicates that the buying-latitude in the field is more closely restricted than ever before.

Labor conditions remain precarious. Shovelers especially were in demand, although the pay is the highest ever known and the men employed earn as high as $10 to $12 on a single shift. Some accidents were reported, one at the Jefferson mine, near Hazel Green, following a cave-in of supporting pillars resulting in the death of three miners. Exploration work in the field has been reduced considerably and at the end of the month little construction work was in progress in any of the districts.

BRITISH COLUMBIA

PORTLAND CANAL AND DOLLY VARDEN DISTRICTS ARE FLOURISHING.

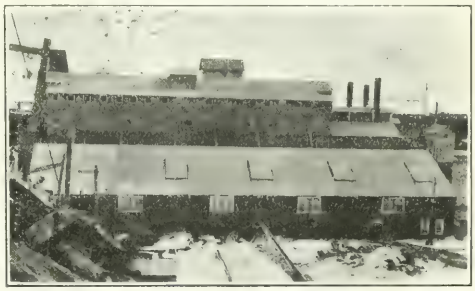
WINDERMERE.—Construction of a second unit of the power-plant for the Florence mine, at Princess creek, is well under way. The company is employing 60 men, and working a double shift in the mine and a single one in the mill. About 150 tons of ore is being treated daily, and it is expected that over 300 tons of concentrate will be produced each month. The mine is in splendid condition, both the fissure and replacement veins yielding a good supply of ore. More miners are needed.

The Laib Brothers, who are operating the Spokane group, are crushing the ore in an arrastre and running the pulp over amalgamated copper plates, and tables. Most of the gold is collected in the arrastre and on the plates and the silver-lead concentrate is shipped to Trail. Transportation facilities are bad, the cost of shipping to the smelter running from $50 to $60 per ton.

PRINCETON.—E. T. Hodge, late professor of mining at the University of British Columbia, has bonded the Emancipation group of eight claims, at Jassica, 15 miles from Hope. Some good ore was taken from this property in 1916 by C. H. Lighthall, who had an option on the property, 53 tons yielding $18,295. Later in the same year F. Merrick netted $2822 from eight tons of ore shipped to the smelter. D. C. Coleman, president of the Canada Copper Corporation, has announced that the railway from Princeton to Copper Mountain should be finished by September 1, and the corporation expects to start milling on that date. The West Kootenay Power & Light Co. has nearly completed its 115-mile high-power branch to the property.

STEWART.—It is declared that there is no mining boom in the Portland Canal district, but that there is much solid development. Nine diamond-drills now are in operation, two on the Premier, two on the Northern Light group, one each on the 49 group, the Big Missouri, the Mother Lode, Goose Creek, and the B. C. Exploration Co.'s property on Marmot river. It is stated that the snow is rapidly disappearing from the higher reaches and that there is still employment for good miners.

Activity is apparent through the country contiguous to the Bear River valley. Men are engaged in putting the line of the Canadian Northeastern railway, owned by Sir Donald Mann, in shape for operation, and a gas-locomotive has been bought, together with some rolling



TINTIC MILLING CO.'S PLANT AT SILVER CITY, UTAH

stock, in order that the transport of supplies to the various camps may be undertaken as soon as the repairs to the road render it feasible. On the Q. & L. group, held under bond by J. Tretheway, of Cobalt, surface-stripping has exposed a vein and a tunnel has exposed ore containing galena, zinc-blende, and silver.

ALICE ARM.—The population of the town of Alice Arm is growing to such an extent that much building is in progress. A three-story hotel is under construction in addition to numerous cabins. The community radiates prosperity. Everyone is busy and the Dolly Varden railway is operating regularly. Reports are received regarding the richness of the new ore being found in the Dolly Varden mine. It is stated also that the Royal group nearby is showing up well. Prospectors are going into the hills both up the Kitsault and the Illiance rivers.

USK.—High-grade copper ore is reported on Nicholson creek, near Usk, by Alexander Baxendale, a prospector. As a result the Crescent group of mineral claims has been staked. Stripping is said to disclose a fissure vein, one to six feet wide, for a distance of 700 ft. carrying bornite and chalcopyrite, much of which is rich enough to ship.

SLOCAN.—That the Utica mine will be re-opened at once and put on a shipping basis is announced by C. F.

Caldwell, vice-president and managing director of the Utica Mines Ltd. The old Sunset property, situated near the Utica, also is to be developed. The latter has not been worked for fifteen years. During its operation over $500,000 worth of ore was shipped, some 2000 tons averaging over $250 per ton at the former price of silver. It is proposed to continue the existing cross-cut to strike the vein at new depth.

NELSON.—Another deal is reported in connection with the Granite-Poorman mine, on Eagle creek, it being stated that a syndicate has been formed to take over the property from the Vincent Development Co. As a result the Granite-Poorman property will resume operation immediately, a crew of men already having been put to work.

ONTARIO

PROVINCIAL MINES DEPARTMENT TO BE INVESTIGATED.

TORONTO.—An investigation which has been for some time in progress into sales of timber by the former Provincial administration has resulted in the discovery of extensive frauds, occasioning considerable loss to the public treasury. As until recently the Department of Mines was included in the jurisdiction of the former Department of Lands, Forests, and Mines, it is suspected that a laxity of administration, if nothing worse, may have resulted in similar abuses in connection with mining sales or leases, and Premier Drury has announced that a thorough investigation of the Department of Mines will be held. In view of the facts as disclosed by the timber investigation, no other course appears open to the Government, and the action meets with general public approval.

PORCUPINE.—The shareholders of the Hollinger Consolidated have approved of the removal of the head office of the company from Toronto to Timmins. A contract has been let for diamond-drilling the Miracle property south of Night Hawk lake, the work to be started as soon as possible. It is planned to tap the main vein at 300 and 500 ft. The property, previous work on which yielded promising results, is equipped with a mining and a milling plant.

KIRKLAND LAKE.—At the Ontario Kirkland work has been started on the excavation for the mill. It is planned to have the foundations and perhaps the framework of the building completed before winter. Drifting on the 450-ft. level is being actively carried on, the ore being richer than on the upper levels. Operations at the Wright-Hargreaves have been handicapped owing to shortage of power. The main shaft was unwatered some weeks ago and work started, but it had to be abandoned through failure of the Northern Ontario Light & Power Co. to deliver enough electric energy. Steam-power is being used on shaft No. 2, which has been straightened and timbered to a depth of 200 ft. The foundations of the mill have been completed and work started on the building, which is expected to be finished and the machinery installed late this fall. The date for commencing milling operations has been indefinitely postponed owing to the power shortage. A vein about 10 ft. wide has been opened on the Wood-Kirkland in a dike of porphyry formation stated to be about 400 ft. wide. Several veins have been uncovered by surface work on the Moffatt-Hall claims near Mud Lake. Trenching is being carried on to ascertain the best point for sinking. At the Chaput-Hughes the shaft is down 40 ft. on a 5-ft. vein, the gold content of which shows an increase at depth.

SESEKINIKA.—On the Russell claims, adjoining the Smith-Labine group, a discovery regarded as being of importance has been made. Trenching has revealed a schisted zone, about 70 ft. wide, cut by numerous quartz stringers of low gold content. The quartz, which is highly enriched with pyrite, is blue in color and the stringers are usually narrow. The shaft on the Lightning River Gold Mines properties, 2½ miles east of Sesekinika Station, is down 20 ft., the vein showing improvement and maintaining its width.

COBALT.—During the first six months of 1920, the silver mines of Northern Ontario produced approximately $6,372,000, according to preliminary estimates. This compares with $12,747,621 for the whole of 1919 and shows how production is being maintained. The total silver output since the first discoveries in Cobalt in 1903, up to June 30 of 1920, amounts to 309,011,136 oz. valued at $188,411,972. Dividends paid amount to some $84,000,000, while the treasuries of the various companies contain upward of $15,000,000, the net profit realized approximating 50% of the total production. The sixth high-grade ore-shoot to be opened since last fall is reported this week on the Beaver Consolidated. There is some promise of regular quarterly dividend disbursements.

The regular quarterly dividend of 5% declared by the Nipissing on July 20 is not accompanied with the usual bonus of equal amount. The company has quick liquid assets of over $5,000,000, the highest figure in its history, and the failure to pay a July bonus is interpreted as indicating the intention of the directors to yield to the request of shareholders to distribute its surplus more freely among stockholders. It is believed this will take the form of a substantial capital reduction at intervals, in addition to regular dividends.

Arrangements are being made to diamond-drill the Mohawk-Cobalt property in the Mud Lake district. An investigation of the possibilities of the Belle-Ellen mine in South Lorrain is being made by M. J. O'Brien, Ltd., with a view to recovering cobalt from the large veins on the property. Another shipment of ten or eleven tons of high-grade ore has been made from the Castle property of the Trethewey company. The ore contains, on an average, 2000 oz. of silver per ton. Current production is adequate to pay expenses, in addition to carry on necessary development work. Announcement is made that the Kerr Lake Mining Co. has arranged a contract with the Dominion Reduction Co. to treat between 75,000 and 100,000 tons of low-grade mill-ore. The Kerr Lake company will itself continue to mine its medium and high-grade ore.

CHILE COPPER CO.

The Chile Copper Co.'s report for 1919 emphasizes that in spite of world-wide economic and social readjustment since the Armistice, the finances of the company have been well husbanded and operations singularly successful, considering conditions under which Chile is working.

"Upon signing of the Armistice," it adds, "large stocks of copper were left on the market and coincidentally sales for about four months practically ceased. This necessitated curtailment in production. For the year ended December 31, 1919, your company produced 38,359 tons, compared to 51,068 for 1918. Capacity of plant during 1919 was approximately 60,000 tons. In spite of small production for 1919 actual cash cost of producing this copper, including estimated cost of selling and delivering, was 13.01c. per pound, compared to 13.30c. for 1918. During 1919 Chilean exchange was more favorable than in 1918, which helped to reduce the cost of production. On the other hand, it is estimated that nearly all other factors entering cost of production were considerably higher in 1919 than in 1918."

For the year ended December 31, 1919, a deficit of $2,290,658 after all charges and taxes, against a surplus of $3,440,229 in 1918 is reported. The combined income account of Chile Copper Co. and Chile Exploration Co. follows:

	1919	1918	1917
Operating revenue	$10 350 167	$20 931 071	$18 908 855
Operating costs	8 729 956	12 414 667	11 751 778
Operating gain	1 620 211	8 516 404	7 157 077
Miscellaneous income	868 877	437 263	649 294
Total income	2 489 088	8 953 667	7 806 371
Federal taxes and miscellaneous	395 556	776 995	505 233
Interest charges	2 823 043	2 422 419	1 860 525
Deficit	729 511	*5 754 253	*5 440 613
Plant superseded	65 639	41 441	1 026 586
Ore depletion	1 355 508	2 132 583	1 710 615
Amount of bond discount	140 000	140 000	105 000
Deficit	2 290 658	*3 440 229	*2 598 412

*Surplus.

ARIZONA

Bisbee.—The work of pouring concrete in the Dallas shaft of the Copper Queen branch of the Phelps Dodge Corporation is now under way. Eventually this will be the main hoisting shaft for the entire Copper Queen mine, and will replace the Sacramento, through which the ore is hoisted at present. Owing to steam-shovel operations, in the course of time the Sacramento will have to be abandoned as an operating shaft.

Maricopa County.—At the Mammoth mine, near Superstition mountain, on the road between Mesa and Roosevelt, application has been made for the establishment of a post-office, and the changing of the name to Youngville, after the chief operator and owner, George U. Young, former Secretary of State. It is reported that new equipment is being purchased and development work is planned on an extensive scale.

CALIFORNIA

Grass Valley.— With 80 stamps dropping on high-grade mill ore from Empire and Pennsylvania mines, the Empire Mines Co. is doing well despite high labor and operating costs. The mine force has been increased and development of new territory below the 4500-ft. level is proceeding satisfactorily. Opening of ore in new ground has been attended with encouraging results during the past year. In the Pennsylvania property good ore is also being opened at depth. The output is sent to the Empire mill over an electric railway.——Excellent developments are reported at the North Star, Alcalde, and Boundary properties. The Central mill of the North Star company is running steadily on good ore from deep levels. Shoots of bonanza quartz continue to develop in the Alcalde and Boundary properties, and both mines promise to be consistent producers. At the Allison Ranch drifting is proceeding along the new-found Hartery vein, with indications pronounced good for development of a large orebody in virgin ground.

Portola.—Regular shipments of copper concentrate are going out from the flotation-plants of the Engels and Walker mines, with new developments adding to the present ore-reserves of both properties. Recent work in the Superior section of the Engels group has placed in sight some of the richest deposits ever found in this district, and the grade of ore going to the plant continues excellent. Activities at the Beardsley, Gruss, Trask & Coffer, Five Bears, Feather River, and several other properties continue. Practically every company reports development of additional ore, with new work materially extending the dimensions of the proved reserves.

IDAHO

Couer d'Alene.—The mines of this district have paid in dividends in 35 years $95,082,316, nearly half of this in the last seven years. At the present rate of earnings the $100,000,000-mark will be passed next year. Dividends in the first six months of the present year were $2,660,357, and will probably continue at about this rate. The individual companies paid: Bunker Hill & Sullivan, $981,000; Hercules, estimated, $500,000; Interstate-Callahan, $373,300; Hecla, $350,000; Federal, preferred, $299,757; Caledonia, $156,300.

A new vein of fine ore has been uncovered by the Columbus Mining Co. The vein is 13 ft. wide and its discovery follows continuous work for two years.——Raising is in progress from the main-tunnel level of the Nabob Consolidated mine. The raise has attained a height of 20 ft. and will be continued to the next level above, which is 220 ft. higher than the main tunnel. The work will be completed in six weeks.——The Orogrande Gold Mining Co., near Stites, has increased the capacity of its mill to 500 tons daily. The designed capacity was 300 tons. Changes and improvements have been made in the method of ore-dressing. ——Workings of the Baltimore vein of the Silver Triumph Mining Co. have been entered for the first time in 30 years. Ore containing 39 oz. silver per ton, 20% lead, and 18% zinc has been discovered 60 ft. from the surface. The old workings honeycomb the ground on two tunnel-levels. The orebody between the main-tunnel level and a point 150 ft. deeper is six feet wide and gives promise of a greater width.

The Tamarack & Custer Consolidated Mining Co. is producing crude ore and concentrate at the rate of 3500 tons per month. The net value of the ore is said to range from $100 to $125 per ton. The purchase of a tunnel that penetrates an adjoining property is under consideration. This tunnel attains greater depth than any on the Tamarack & Custer and is convenient to a mill. Its use by the Tamarack & Custer will reduce the cost of mining.

MISSOURI

Joplin.—The Iowa Mining Co. is erecting a mill on its lease on the Gilmore land, two miles south of Baxter Springs, and expects to have the plant in operation by September 1. The mill was formerly the old Oak Orchard, north of Joplin. It is of 150 tons capacity and is in good condition. It is equipped with gas-engines, which will be the motive power at the Iowa mine. Ben Hoskins, millbuilder of Baxter Springs, is in charge of the construction work. A feature of the plant is that the building will be covered with a new roof entirely of zinc. Zinc sheets will be used and so placed as to conform to the best methods of laying roofing of this kind, allowing for expansion and contraction.

The Iowa company has had many obstacles to overcome in the development of its mine. The lease is regarded as one of the richest in the district. Eighteen or nineteen holes were sunk in the prospecting and a fine body of ore blocked out. Spasmodic troubles with water delayed operations at times and just when everything seemed to be ready for a continuation of mine development a fire destroyed nearly everything at the plant. After re-building the engine-house and derrick, work was resumed underground and negotiations were started looking to the purchase of a mill.

NEVADA

Searchlight.—A. S. Gaines and Charles Johnson have found some fine ore on their lease on the 600-ft. level of the old Duplex mine. The find is said to be similar to that made about two months ago by Burdick and Perkins on the 500-ft. level of the Duplex. Burdick and Perkins are still mining ore worth about $200 per ton and are shipping at the rate of a car every eight days. Gaines and Johnson expect to begin shipments at once.

UTAH

Grantsville.—Promising mineralization has been penetrated in the adit being driven at the 'L' Marie property to open at depth a shoot of good ore previously opened by a shallow shaft. This property is situated in the Free Coinage district, nine miles east of here. In the face of the tunnel, which is about 75 ft. from the portal, four inches of high-grade silver-lead ore, containing manganese and spar, has been cut.

Bingham.—Upper workings at the United States properties here are to be turned over to lessees, according to D. D. Muir, mine manager. The United States properties include the old Jordan and Galena mines, from which high-grade galena was mined in the early days.

Alta.—Since June 15, the South Hecla company has been shipping an average of one carload of ore per day, according to George H. Watson, general manager. At present 57 men are employed at the property, and twice that number could be used to advantage, if they were available. A similar shortage of men exists in the other mines in the district.

WASHINGTON

Stevens County. The only mining company in Washington that is now paying dividends is the Electric Point which has made two disbursements this year and expects to continue its present rate of $23,790 per quarter. The Northwest Magnesite Co. is making good profits but has not yet declared any dividends. The American Minerals Production Co., also a magnesite corporation, paid a dividend of $30,000 in 1917 and may resume payments before long, in view of the present condition of the mine.

A concentrating plant has been erected at the Lead Trust mine and has started operation. The plant is of 75 tons daily capacity and designed to dress lead ore. Operations have disclosed ore 6 to 14 ft. wide on two levels. One level is 200 ft. above the mill and the other 350 ft., both being opened with adits.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

F. L. Sizer is in Arizona.

J. Power Hutchins writes from Italy.

W. Pellew-Harvey, of London, is at Vancouver.

A. Campbell, of Anaconda, visited Globe recently.

Algernon Del Mar, of Los Angeles, is at Alamos, Mexico.

Wilber Judson is on his way back to New York from San Francisco.

Charles Janin left Penang, Straits Settlements, for London on July 7.

E. O. Daue has returned to Bluefields, Nicaragua, from Easton, Pennsylvania.

William R. Bishop and **F. L. Watson,** of Lima, Peru, are visiting the South-West.

Frederick F. Ransom is doing geological work in the oilfields near Santa Maria, California.

D. A. Lyon, supervisor of stations for the U. S. Bureau of Mines, was recently in San Francisco.

John Davenport, formerly of Boston, is at Wausau, Wisconsin, in care of the Wausau Abrasives Co.

Robert M. Hampton, of Tonopah, is now superintendent for the Utah Boston Development Co., at Bingham, Utah.

W. S. Hall, metallurgical engineer for the Chino Copper Co., at Hurley, New Mexico, is visiting metallurgical plants in Utah.

Paul T. Bruhl has left Thomson, Georgia, and is now with the New York & Honduras Rosario Mining Co., at San Juancito, Central America.

M. J. Finnegan, of Worcester, and **E. L. Marsh,** of Boston, who are interested in Nevada and Utah mining properties, were at Salt Lake City recently.

W. Prouty, geologist for the Old Dominion company at Globe, has been appointed chief geologist for the Copper Queen branch of the Phelps Dodge Corporation at Bisbee.

R. A. Sulliger has left the Estaca Mining Co., at Contra Estaca, Mexico, to take charge of the Delores Esperanza Co., at Delores. **H. D. Hickie** succeeds him as superintendent for the Estaca Mining Co.

M. J. Gavin, refinery engineer for the U. S. Bureau of Mines, with headquarters at Salt Lake City, visited the San Francisco office of the Bureau during June in connection with oil-shale development.

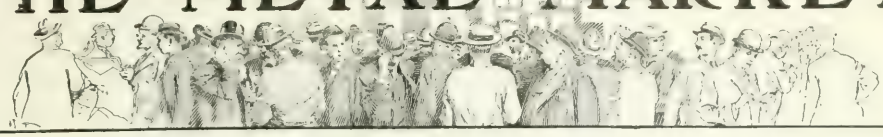
W. E. Dickson, assistant engineer, and **R. R. Rowe,** junior engineer of the U. S. Geological Survey at Salt Lake City, are at Wabuska, Nevada, installing a new recording-gauge station on the Walker river.

T. H. O'Brien, for twelve years manager for the Stag Canyon Fuel Co., at Dawson, New Mexico, a subsidiary of the Phelps Dodge Corporation, has been appointed general manager for the Inspiration Con. Copper Co. and also for the International Smelting Co.

Dewey, Strong & Townsend announce the entry of Capt. **William A. Loftus, Thomas Castberg, James M. Abbett,** and **John H. Herring** into the firm, which will be known as Dewey, Strong, Townsend & Loftus, with offices as heretofore in the Crocker building, San Francisco.

J. M. Hill, of the U. S. Geological Survey, has been transferred from Washington to the Survey's office in San Francisco, where he will be associated with **Charles G. Yale.** Mr. Hill's field of geological studies will include the Pacific Coast States and to some extent also Arizona and Nevada. The desirability of having a geologist attached to the San Francisco office has long been felt, for many requests for examination and report are received that cannot be met by sending a Federal geologist across the continent.

THE METAL MARKET



METAL PRICES

San Francisco, July 13

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.00
Copper, electrolytic, cents per pound	19.00
Lead, pig, cents per pound	8.25—9.25
Platinum, pure, per ounce	$85
Platinum, 10% iridium, per ounce	$118
Quicksilver, per flask of 75 lb.	$85
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

July 12.—Copper is quiet and strong. Lead is inactive but firm. Zinc is dull but steady.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid $1 per ounce for all silver purchased by it, fixing a maximum of $1.01½ on August 15, 1918, and will continue to pay $1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine) calculated at the normal rate of exchange.

Date	New York cents	London pence
July 6	90.00	51.50
" 7	91.87	52.50
" 8	94.50	54.00
" 9	91.75	52.25
" 10	92.12	52.62
" 11 Sunday		
" 12	92.87	53.12

Average week ending	Cents	Pence
May 31	101.17	58.87
June 7	98.23	56.52
" 14	86.00	48.02
" 21	87.07	48.73
" 28	91.41	51.69
July 5	89.97	51.68
" 12	92.18	52.66

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	....
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	....
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	
July 6	19.00
" 7	19.00
" 8	19.00
" 9	19.00
" 10	19.00
" 11 Sunday	
" 12	19.00

Average week ending	
May 31	19.00
June 7	19.00
" 14	19.00
" 21	19.00
" 28	19.00
July 5	19.00
" 12	19.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	....
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	....
Mch.	23.50	15.05	18.15	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	
July 6	8.25
" 7	8.25
" 8	8.25
" 9	8.25
" 10	8.25
" 11 Sunday	
" 12	8.25

Average week ending	
May 31	8.50
June 7	8.68
" 14	8.75
" 21	8.21
" 28	8.15
July 5	8.39
" 12	8.25

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	....
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78	....
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	....
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.88	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	....
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	....
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	
July 6	8.20
" 7	8.15
" 8	8.10
" 9	8.15
" 10	8.15
" 11 Sunday	
" 12	8.15

Average week ending	
May 31	7.92
June 7	8.02
" 14	8.00
" 21	7.79
" 28	7.85
July 5	8.04
" 12	8.15

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	....
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	....
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	
June 15	85.00
" 22	85.00

June 29	85.00
July 6	90.00
" 13	85.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	....
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	....
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	....
Apr.	110.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

FOREIGN VIEW OF THE PITTMAN ACT

The New York market for silver and the operation of the Pittman Act have been followed with interest by bankers and bullion dealers in Europe. Under influences tending to depress silver in world markets, such as Chinese selling and Continental selling of silver coins, Europe watched the price decline in this market well below the dollar mark, with the Pittman Act ineffectual for the time being. Now that the Treasury has found a means of putting the Pittman Act into operation, and thus stimulating the price even for foreign silver, practicability of the measure is still questioned by foreign dealers.

Advices to hand reflect views of foreign dealers on information that the Director of the Mint had revised its regulations regarding tender of silver of United States origin, although mixed with alien-produced silver in refining. Resultant stimulation of silver in New York by this means is regarded as rather artificial and as tending to be against commercial interests of United States citizens in settlement of trade obligations with China, or where debts are to be paid in silver.

Samuel Montagu & Co., bullion dealers, of London, say: "There are two good reasons, both touching the well-being of the people of the United States, why silver sold under the Pittman Act should not be purchased at a dollar the fine ounce. First, there is the prospect that if the dollar limit were removed their silver could be acquired at a substantial discount of 25% or more under the dollar per fine ounce. Second, the balance of trade with China was against the United States to extent of $14,684,000 in 1914 and in 1919 had increased to $48,639,000 (nearly 3½ times).

"Any fall in the price of silver must have material effect in reducing to people of the United States the cost of commodities from the Far East. In the above figures a fall of 50% in the price of silver would not only show an apparent gain of £5,000,000 to people of the United States, but it would really mean many times more, for trading and manufacturing profits connected with raw material imported from China would be, to a large extent, proportionately lessened by a reduction of wholesale and retail prices."

TAXES AND NATIONAL DEBTS

Financiers of experience and vision continue to stress taxes and public debts as factors of the utmost importance financially. Otto H. Kahn thinks the excess profits tax is the source of much economic evil and gives excellent reasons for his belief. Another economist, who is not of the banking fraternity, thinks there is great danger of the world's gold reserves becoming inadequate, and suggests that gilt-edge gold interest-bearing bonds be made the basis of the currency by Congress if a great crisis is to be averted owing to the deflation of credit just when inflation is needed, or later will be needed, by expanding business in this country and in Europe.

As to national debts there is perhaps less awe of the great indebtedness piled up since 1913. Everything is relative. Is Britain's present war debt any greater, relatively speaking than the four billions she owed at the end of the Napoleonic wars? It is not. Britain is a great many times richer than she was 124 years ago. If this is true of the English what is to be said of the war debt of the United States which country, equally rich, though only half developed, has a war debt of $30,000,000,000.

MONEY AND EXCHANGE

Foreign quotations on July 13 are as follows:

Sterling, dollars	Cable	3.93⅞
	Demand	3.94⅝
Francs, cents:	Cable	8.42
	Demand	8.44
Lire, cents:	Demand	6.06
Marks, cents		0.64

Eastern Metal Market

New York, July 7.

The three-day holiday has not been a stimulus to an already rather lifeless market. Prices have, however, remained fairly strong.

Buying of copper is only moderate but prices are steady and unchanged.

Business in tin is confined to dealers and is light.

Demand for lead is small. Prices are firm but nominal.

The zinc market is stronger and prices are higher.

Antimony is unchanged and quiet.

IRON AND STEEL

Pig-iron output increased in June, showing that the net result of all the changes in the railroad situation was favorable. At 3,043,540 tons for the 30 days the daily average was 101,451 tons, a gain of about 5000 tons per day upon the May output, which was 2,985,682 tons for 31 days. May in turn showed a gain of 5000 tons per day over April. But the industry is still nearly 7500 tons below the peak reached in March when the daily average was 108,900 tons. The estimated capacity active at the opening of the month was 101,500 tons per day, against 98,350 tons for 295 furnaces on June 1.

The latest word from steel-producing centres, however, indicates a more unfavorable turn, within the week. The Commerce Commission order that open-top cars be sent to coal mines and the renewal of the order directing box-cars to grain-producing sections have left steel-mills so short of cars that there is increased talk of a suspension of operations for ten days or two weeks to permit of a clearing up of the desperate congestion.

While reports from the automobile industry have been unfavorable, two companies made records in June, one turning out 3500 cars per day and another 625 cars.

Cars bought by industrial companies have amounted to 6500 since May 1 and active inquiries will bring the total to 10,000.

COPPER

Conditions as to labor and transportation are not greatly altered. Demand continues light from domestic sources but buying for foreign shipment is good. There is more interest for forward shipment by domestic buyers, and sales have been made of both Lake and electrolytic copper, for forward as well as prompt and early delivery, on the basis of 19c., New York. Large producers are firm in their quotations of 19c. for both grades. The outside market is believed to have been pretty well cleaned out of speculative and cheap lots and is quoted at around 18.50c., New York, for early delivery.

Statistics regarding copper exports show that to June 1 these have been at the rate of 30,906 gross tons per month and that the average for the half year will probably be 30,000 tons per month. This compares with 19,000 tons per month in 1919 and 32,000 tons per month in 1913, the record before the War. Exports during the War were highest at 41,000 tons per month in 1917.

TIN

There has been no heavy buying in this market recently. Such as has been reported has been mostly on the part of dealers and has not exceeded 100 tons. Consumers are not interested. Dealers, however, appear to be optimistic about the future of prices and this is the reason for this activity, but there are, however, few sellers. Until Friday of last week there was almost no buying, but late that day a few dealers were buyers of future shipment at prices ranging from 47.75c. to 49c. and at the close 49.50c. was asked. Spot Straits tin is scarce and prices are nominal and fairly stiff, closing on Friday at 50.25c., New York. Yesterday, however, the market was nominally lower at 48c., New York, due to a decline in London over the holiday from £273 per ton on July 2 to £259 yesterday.

Tin arrivals in June are reported to have been 4730 tons, of which 900 tons came in at Pacific ports. The amount of tin delivered into consumption in June was 6500 tons, of which 5600 was from Atlantic ports. The quantity in stocks and landing on June 30 was 3586 tons. Imports to July 1, this year, have been 27,743 tons, of which 20,820 tons was Straits tin. To July 1, 1919, the imports were only 6341 tons.

LEAD

The market is quiet and quotations are nominal. The undertone, however, is strong. There is a marked scarcity for certain positions. It is almost impossible to purchase prompt-shipment metal and spot delivery is scarce. There is, however, almost no demand for either position. There has been no change in the quotation of the American Smelting & Refining Co., which is 7.75c., St. Louis, or 8c., New York. An appraisal of the outside market is a guess, but it may be conservatively quoted as nominal at 8c., St. Louis, or 8.25c., New York. Quotations range up to 8.50c., New York.

ZINC

The market is stronger and prices are higher. This is due to three causes. One is the shutting-down of most of the mines in the Joplin district, due to labor troubles and the exodus of men to the farms. This will last a month at least and thus reduce the supply of ore. Another cause is a better inquiry from galvanizers and brass-makers, and the third reason is a stronger London market. Prime Western for early and third-quarter delivery is quoted at 7.85c., St. Louis, or 8.20c., New York, with fair inquiries reported.

ANTIMONY

Quotations are unchanged at 7.50c. to 7.75c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted in wholesale lots for early delivery at 33c., New York, by the leading interest and at 31.50c. by other sellers.

ORES

Tungsten: There is no life to the market and no features. Quotations are nominal at $5.50 to $15 per unit, depending on the grade, the quantity, and the delivery.

Ferro-tungsten and tungsten powder is quoted at 85c. to $1.05 per pound of contained tungsten, f.o.b. makers' works.

Molybdenum: Conditions are unchanged with prices nominal at 75c. to 85c. per pound of MoS_2 in regular concentrate.

Manganese: The market is strong at 70c. to 75c. per unit for high-grade ore. A large consumer has contracted for 20,000 tons per month of Indian ore, deliveries commencing last month to continue one year. Imports in May were 56,586 tons, the largest for any month this year. The total for the 11 months to June 1 this year is 243,572 tons, against 444,902 tons to the same date in 1919.

Manganese-Iron Alloys: Demand is light and quotations are firm at $200, delivered, for domestic alloy for last half, with $195, seaboard, for a limited quantity of British alloy. The spot quotation is $225, delivered. Imports of ferromanganese in May were 3981 tons, or the largest in a year and a half. The total for the 11 months to June 1, 1920, has been 33,279 tons, as compared with 22,200 tons to June 1, 1919. The spiegeleisen market is strong but quiet at $75 in place.

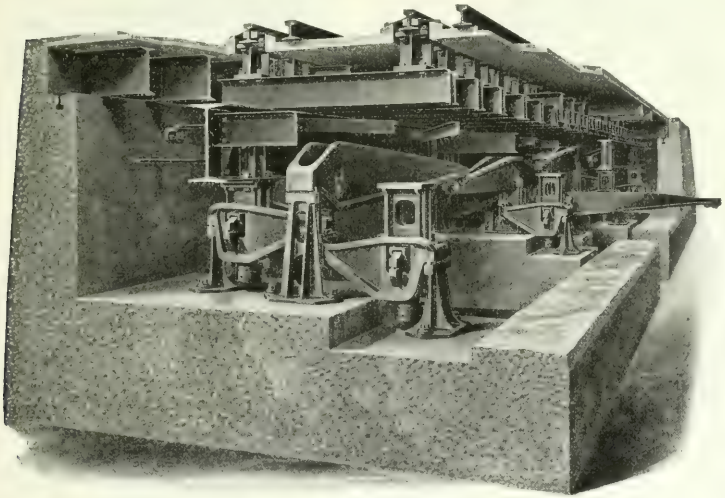
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

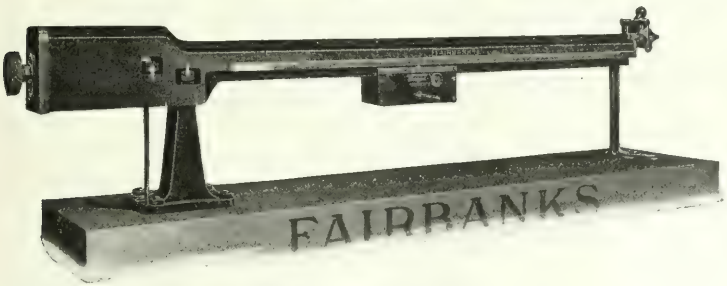
A NEW TRACK-SCALE

By L. R. Boyer

A new track-scale embodying many new and exclusive features has been developed by E. & T. Fairbanks & Co., St. Johnsbury, Vermont, manufacturers of the well known Fairbanks scales. This was occasioned partly by new specifications adopted jointly by the American Railway Association, the American Railway Engineering Association, and other organizations. These specifications make necessary such changes in the design of scales on the market up to this time, that the new scales in accord with them are not interchangeable with the old scales. While changes were being made that were sufficient to destroy the interchangeability of the new and old, it was decided to go further and remove incongruities in design that have been present in scales ever since the first were built nearly ninety years ago. The feature first noticed on looking at the accompanying illustration is the departure from the use of the customary I-section levers, and the consistent use of the double-web section throughout.



Construction of New Track-Scale



Newly-Designed Scale Beam

The scale is built in two capacities for light-duty service, or service where only a relatively small number of cars is to be weighed. These have 60 and 75-ton sections and lengths of 50 ft., 56 ft., and 60 ft. effective weighing rail. For heavy service or where a large number of cars is to be weighed the scale will be built in 75 and 100-ton sections and in the same three lengths as above. The difference between the light-duty and heavy-duty scales is mainly in the loading per linear inch of knife-edge, this being 5000 lb. in the heavy-duty scales and 6000 lb. in the light-duty scales. The difference in allowable loading and the allowance of a higher multiple main lever in the light-duty scales serves to make somewhat lighter castings than are necessary in the heavy-duty scales.

The beam in keeping with the other parts of the scale is novel in design. A close study will reveal that this design includes well accepted principles essential to an accurate and durable mean and the difference in appearance from the conventional type of beam is due to a consistent use of these principles. It is of cast-iron with cross-section of inverted-U shape. This shape, besides giving the maximum rigidity, furnishes a housing over the balance-ball and track for carrying the poise. The notches are cut in a steel bar inserted in the bottom of the back web, which ensures that no dirt can fall and lodge in them. The type for printing weights on tickets is fastened on the bottom of the front web where it is protected from damage.

The centre indicating poise suspended from three ball-bearing trolley-wheels runs smoothly upon a machined track housed inside the beam. Its exact weighing position is determined by a positive locking device of 30 or more teeth engaging the same number of notches of the beam. This locking device or pawl moves in vertical guides arranged to be always tight, to ensure a positive position of the poise. A convenient handle on the front of the poise

serves to operate the pawl when turned in one direction and to print the tickets when turned in the other direction. The beam stand is of the upright pillar type with compensating steel bearing-blocks machined in.

Standard erection-plans have been drawn which incorporate the best recognized practice as to all details of installation. Wide pits afford ample room for installing the scale correctly as well as for convenient examination from time to time. The design of weigh-bridge, the mounting of dead-rail supports and fastening, the arrangement of weather guards, and all other details have been worked out carefully, with a view to obtaining the most economical way, consistent with accurate performance and at the same time, the lowest maintenance cost.

HOW THE MOTOR-TRUCK MAY RELIEVE CONGESTION AT FREIGHT TERMINALS

By R. E. Fulton

Freight congestion is, in reality, terminal congestion. The present railroad situation vividly demonstrates that the root of the much discussed railroad inadequacy lies more in the lack of proper terminal facilities than it does in the lack of freight-cars. It has further proved that the motor-truck, properly used in conjunction with railroad terminals, can relieve terminal congestion and increase the productivity of each unit of the railroads' rolling stock.

Although it is estimated that the railroads of this country now need 500,000 more freight-cars, it is obvious that, if this number of cars were put into service under existing terminal conditions, the confusion would only be increased. Unfortunately, the majority of railroad terminals were constructed in the days of horse-drawn highway transportation facilities, and no provision was made for the advent of the motor-truck. At that time it was necessary for the railroads to bring their freight within a radius of a day's team-haul of its final destination, a distance considerably less than can now be covered by a motor-truck. Cities have grown and traffic has increased, but the terminals have remained practically unchanged as far as distribution radius is concerned. It is a fact that the average freight-car travels only about six miles per day, and that this inefficiency can be attributed directly to wasted time through congestion at terminals. Considering that we now have over 2,400,000 freight-cars in use, it can be seen that every mile per day added to the productivity of this total by increasing efficiency, is the equivalent of 400,000 cars. Thus it is obvious that if a continuous movement of freight-cars to and from their terminal points can be obtained, a two-fold advantage will result; first, eliminating the delay and waste incidental to congestions, and second, releasing a vast number of cars for main-line traffic.

To say that this can be accomplished by utilizing the motor-truck is not a mere prophecy; it is a proved reality. The few railroads that have applied the use of trucks in their limited way to this problem have met with remarkable success and should stand as uncompromising examples to every railroad now affected by terminal congestion. For example, figures compiled by the U. S. Railroad Administration show that in the Big Four yards at Cincinnati, the use of motor-trucks with demountable bodies has reduced the time required per ton-mile for transfer shipments from 12 hours and 18 minutes, to less than 3 minutes. This saving of time is accompanied by a reduction of fifty cents per ton-mile on the cost of the transfer shipments. The motor-truck is now a permanent supplement to the railroads and has proved its capacity to take the short-haul traffic that has developed to be time-wasting and unprofitable business for them. By 'feeding' short-haul shipments to the main-line traffic, it has released thousands of cars for long-distance transportation and has done much toward relieving congestion at terminals.

CONVEYING HOT MATERIAL BY BELTS

An unusual problem in the handling of hot cement clinker with a temperature of 200° and over, was recently solved at the plant of the Standard Portland Cement Co. at Leeds, Alabama. The method decided upon for moving the clinker was a rubber conveyor-belt, but the clinker could not be cooled sufficiently in the process previous to conveying to prevent scorching of the belt and its rapid destruction. The answer to this problem was found by running the belt at an incline of 12°, so that the lower pulley dipped into a trough of water, thus carrying a film of cold water upon the belt, onto which the hot clinker from the loading hopper was deposited. At this point a new problem was met; namely, how to join the belt so that the belt's full strength would be retained, and in a way which would withstand the extremes of temperature, the wear on the pulleys and the abrasion of the clinker. For this purpose Crescent belt-fasteners were used, because they brought the belt ends tightly together in a snug joint, which made the belt practically endless on the pulley-side, so there was no opportunity for clinker-ash to get into the joint and abrade the belt-ends, and also because in this method of joining, no metal came in contact with the pulleys to cause wear. Moreover, exceptional strength of the heads of the Crescent rivets and the formation of Crescent plates prevented destruction of belt-joint through abrasion by the clinker.

In six months of operation, this conveyor has carried 61,000 tons of clinker, and the Standard Portland Cement Co. credits the saving of $300 in belt-cost alone to this conveyor. The belt used was Goodyear 'hy-temp', which is made particularly to withstand temperatures up to 200°, and is adapted for work on conveying jobs in mines, coking-plants, and cement-factories where heat resistance and ability to withstand hard wear are prime requisites. Not alone on heavy drives, such as tube-mill, Griffin mill, crusher, and heavy conveyor units are Crescent belt-fasteners successfully used, but also on lighter drives of all kinds where dependability is an economic factor, as they assure continuous production. The Crescent Belt Fastener Co. has just published a new hand-book illustrating Crescent belt-fasteners in use on many different kinds of belting and under different conditions.

ASSOCIATION OF ACCOUNTANTS

The Industrial Cost Accountants Association was organized in Chicago on June 18 by representatives of leading manufacturers in various lines of industry. The object of the new association is the standardization of accounting and cost terminology and the adoption of standard governing principles; the promotion of active co-operation and interchange of experiences between representatives of manufacturers engaged in similar activities; the education of the members and their business associates in the complex economic problems of industry; to assist standardization committees in each line of industry in establishing uniform accounting and cost practices; to act as a clearing house in distributing to all members the development in cost practices to the end that uniformity, once established, may be maintained.

M. F. Simmons, of Schenectady, New York, supervisor of costs for all General Electric Co. interests, was elected president of the association. C. H. Smith, of Wilmerding, Pennsylvania, director of clerical operations of the Westinghouse Air Brake Co. interests, was elected first vice-president. Roland H. Zinn, of New York, was elected second vice-president. A. A. Alles, Jr., of Pittsburgh, secretary of the Fawcus Machine Co. and treasurer of the Schaffer Engineering & Equipment Co., was elected secretary-treasurer of the new organization. Headquarters of the association will be in Pittsburgh, at the office of the secretary-treasurer, 1501 Peoples Bank Building.

UNDERGROUND PROSPECTING AT JOPLIN

By F. R. Alger

For years there has been a need for some convenient and economical method of underground prospecting in the lead and zinc mines in the Joplin or Tri-State mining district; and this has been especially urgent in the Picher-Miami section recently developed. It frequently happens that the orebody is worked out and the owners wish to locate, for operation from the same shaft, other bodies of ore on their property, without going to the expense of new openings from the surface. Often the presence of these bodies has been indicated by drilling from the surface. Sometimes their location is roughly determined by the geological indications. It is a well known fact that the 'runs' of ore frequently follow water courses, spreading out at some points and diminishing at others.

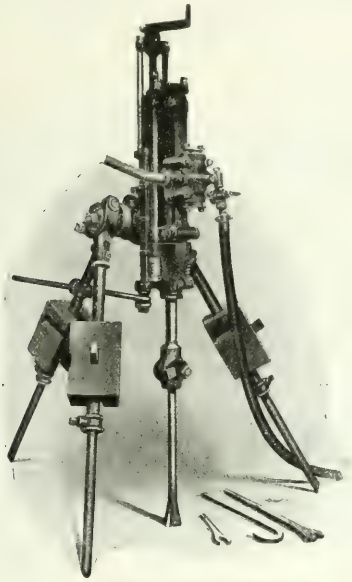


Fig. 1. Sullivan Class FS-3 Rock-Drill

Sometimes the presence of these runs of ore is indicated above the mine stope; frequently they are below the general level of the mine. For this class of work, even in the high stopes of the Joplin district, the use of a churn-drill underground is impracticable. Although diamond-drilling has been demonstrated to be practicable the cost is high.

A method has recently been employed which gives promise of excellent success. This consists in the employment of a Sullivan 'Hy-Speed' rock-drill of large size, mounted on a tripod, and operated by compressed air. The machine employed is the Sullivan Class FS-3 machine, see Fig. 1, with 4¼-in. cylinders, mounted on a Lewis hole tripod, having a planed and slotted front bar, such as is used in quarries for drilling parallel holes to split granite blocks. The FS-3 machine is exceedingly substantial and powerful; it is equipped with a hollow piston and employs hollow drill-steel. With it, holes have been drilled in Joplin-Miami mines to a depth of more than 40 ft. and under favorable condition in this class of work the drill is capable of putting in 60-ft. holes. Round hollow steel of 1⅝ in. diameter is employed. For lengths above 15 ft. the steel is jointed, the joint itself being similar to that used in churn-drill practice. The different sections are connected by means of a double male coupling, see Fig. 2, which fits the upset and threaded female ends of the drill-steel, and makes a substantial and readily handled coupling. A particular advantage of the

Fig. 2. Coupling for Drill Steel

FS-3 drill consists in the cushion valve at the front end of the cylinder. When running into pockets, or caves, damage to the front head may be prevented by throwing a lever near the front end of the drill, which puts a front head cushion into effect and relieves the drill entirely of the shock and danger of breakage from pounding on the front head. This feature is also of value in freeing steel that has become stuck.

This drill can put holes in any direction or at any angle. In the work already done, some holes were directed a little below horizontal, and others at an angle of about 60° above horizontal. The cuttings are preserved in the same manner as cuttings from a churn-drill hole, and provide a reasonably accurate record of the orebody penetrated. The advantages of this method of prospecting are obvious. In the first place the deep holes from the surface, running through 150 to 200 ft. of worthless cap rock, are avoided. In the second place, the angle at which the drilling is done permits the orebodies to be cross-cut, thus furnishing a valuable check on any previous vertical drilling. Third, a large saving in time is effected, as compared with other methods of prospecting.

AN IMPROVED STRETCHER

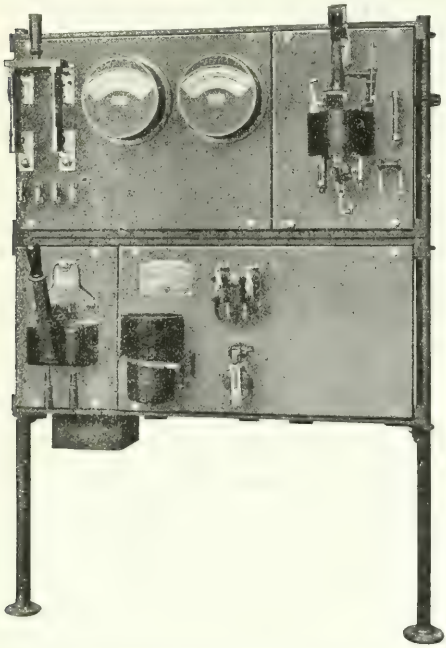
By J. C. Williams

A few years ago I made a litter or stretcher with a joint lengthwise through the centre through which ran a strap, which, when withdrawn, allowed the stretcher to separate like a door-hinge when the centre pin is withdrawn. At that time the care of injured employees took up but little time of the employer, who had not realized that a workman was an asset while he worked but became suddenly a liability when he was injured; the term 'first aid' was not yet coined. However, the largest industrial concerns suddenly woke up to the importance of caring for their employees, many States passed drastic laws to enforce care for injured employees and to guard against accidents. Today the large plant that has not a safety-engineer or first-aid superintendent is the exception and not the rule. We christened our stretcher from its inception 'Williams' Improved Stretcher', feeling sure that would include its past, present, and future, for it has been a succession of improvements—and the end is not yet. The only features remaining unchanged today are, the use of white duck owing to the fact that it can be washed when soiled, while colored ducks cannot be; and the size of the cot which remains, 2 by 6 ft., thus assuring interchangeability. Get a cot from us now and it will fit a stretcher bought of us two years ago. Practically all other stretchers are as alike as 'peas in a pod'—simply a strip of canvas, hem on each end, tacked to wooden handles with braces about one foot from each end for spreaders and iron legs riveted on, there are usually about seventy-five tacks to each side so it is out of the question to take the cot off to wash, in fact, this kind of stretcher is not intended to be washed, but to be thrown away when soiled and new stretchers bought. With our improved stretcher no two component parts are inseparable, for instance, the cot is in two interlocking parts, the rubber strap acting as lock, the spreader and legs are of one piece and easily slipped from the handles, the handles slip through a hem at each side of the stretcher, there are no tacks, no catches of any kind, so when it is taken apart, we have two handles, two spreading-iron and legs, one rubber

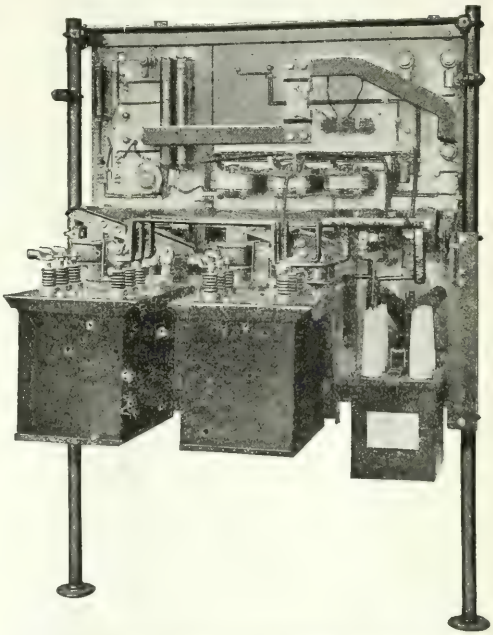
strap, and one each right and left-hand cots. Any and all of these parts can be perfectly cleaned. We sell our stretcher in a dust-proof bag so it reaches the customer clean and can be kept clean, always ready for instant use. Naturally we do not compete in price with the old-fashioned stretcher any more than mazda lamps do with kerosene lamps.

NEW AUTOMATIC CONTROL-PANEL FOR MOTOR-GENERATOR SETS

In mines and metallurgical plants where the direct-current supply is obtained from a motor-generator set, it is frequently advantageous to control the power equipment from some remote point, thus eliminating the necessity of an attendant at the switchboard. Several mines are using with their motor-generator sets an automatic control-panel, shown in the illustrations, which has all the protective features used in the small modern switchboards, and may be controlled from any remote point by means of an ordinary snap switch.



Switchboard for Automatic Control of Motor-Generator Sets



Rear View of Board, Showing A. C. Oil-Switches and Circuit-Breaker

This automatic equipment, manufactured by the Cutler-Hammer Mfg. Co. of Milwaukee, consists of the necessary circuit-breakers, switches, relays, fuses, and recording instruments mounted on slate panels carried on a floor-type frame. The primary equipment of the control-panel shown in the illustration consists of a hand-operated oil circuit-breaker provided with inverse time overload attachments, a phase-failure and phase-reversal relay, and an automatic starter of the auto-transformer type. This is to be used with induction motors, but the same general equipment with a few slight changes can be used with motors of the synchronous type. On the direct-current side a knife-switch, voltmeter, and ammeter with the necessary fuses, and an automatic re-closing circuit-breaker are provided.

With the remote control-switch 'on' the controller may be operated by merely closing the main-line oil circuit-breaker, or the breaker may be left closed and the equipment operated by means of the remote control-switch. The closing of the main circuit-breaker effects the closing of the phase-failure and reversal relay, unless one or more of the phases are open or reversed, in which case the abnormal condition must be moved from the line before the relay will close. This relay has also the characteristics of a voltage-relay, so the equipment will not operate if the line-voltage is very low. After the relay closes, the automatic starter connects the motor through an oil-switch to the low-voltage taps of an auto-transformer. When the equipment has come up to speed, the oil-switch opens and a second oil-switch connects the motor directly to the supply-line, at the same time completing a circuit to the closing-coil of the automatic re-closing circuit-breaker, which immediately closes, establishing the generator voltage on the direct-current feeders. In case of an overload on the direct-current side, the circuit-breaker opens, and re-closes when the overload is removed. The oil-switches used on this equipment were described and illustrated in the January 10 issue of 'Mining and Scientific Press'. These control-panels can be furnished in different capacities up to 300 kw. and, when desired, can be built for operating two motor-generator sets in parallel.

The Worthington Pump & Machinery Corporation announces the purchase from the Platt Iron Works, Dayton, Ohio, of its drawings, patterns, jigs, templates, special tools, good-will, and name, in connection with the following products: (1) oil-mill machinery, suitable for the extraction of oil from all sorts of nut and seed products, comprising crushers, cookers, cake-formers, presses, filters, and pumps; (2) hydraulic turbine and water-wheels, including horizontal and vertical, high and low-head machines; (3) feed-water heaters, steel and cast-iron, horizontal and vertical; (4) high-pressure air-compressors for torpedo and other high-pressure charging, cleaning, and discharging.

T. A. RICKARD, - - - - Editor

SALES of copper during June were 52 million pounds, as compared with 62 in May and 101 in April, making a total of 215 million pounds for the second quarter of the year, as compared with 639 millions during the first quarter and 753 millions in the last quarter of 1919. Thus in nine months 1607 million pounds has been sold, besides 350 millions of copper refined in the other countries. The refinery output in the United States has been about 1250 million pounds during the nine months, indicating a reduction in world stocks of 357 million pounds. That is less than was hoped. At present the stock of refined metal in this country is about 400 million pounds, not counting the copper in course of treatment. The figures for the first quarter of this year show the effect of the crippled railroad traffic, which has been injurious both to production and consumption. It is apparent also that there has been a hitch in the arrangement for financing the export of copper to France. Moreover, our legal state of war continues to militate against our commerce in metals as in other commodities needed by Europe.

IN our last issue we mentioned the fact that the Mining Experiment Station of the U. S. Bureau of Mines has been moved from Golden, Colorado, to Reno, Nevada, because the trustees of the Colorado School of Mines declined to renew the contract whereby the Station was quartered in a suitable building, but offered new quarters in an unsuitable building, and stipulated that all work done by the Bureau in Colorado should be done at Golden. This last proviso seems to have been prompted by jealousy of the University of Colorado, at Boulder, where oil-shale investigations are being conducted by the Bureau. The trustees, it seems, have made a blunder. The editor of 'Chemical & Metallurgical Engineering', Mr. H. C. Parmelee, says: "The transparency of this subterfuge will be evident to those who are familiar with the location of the mill in the creek-bottom and its unfitness for use in the delicate and exact work conducted by the Bureau". This refers, of course, to the new site offered by the trustees. Mr. Parmelee knows whereof he speaks, for he was president of the Colorado School of Mines and had to resign, for reasons that do him no discredit. We are informed that the mining people of Colorado appreciate highly the work done by the Bureau of Mines at Golden and Boulder, and they "deeply deplore the action of the trustees". Meanwhile we note that the Lead and Zinc Experiment Station of the Bureau of Mines is to be established at Rolla, and is to be conducted in association with the Missouri School of Mines at that place.

IN the current 'Atlantic Monthly' Dr. Frederick Starr, the anthropologist, describes Mexican politics for the benefit of the Boston *intelligentsia*. He finds many analogies between conditions upon the opposite banks of the Rio Grande; for example, Carranza's effort to force Ignacio Bonillas upon the Mexican people as his successor in the Presidency was like Roosevelt's successful effort in forcing Mr. Taft upon the American people. In both cases, says Dr. Starr, the result was the disruption of the party and war to the knife, but he overlooks the fact that the "war to the knife" in one case was figurative and in the other literal. He seems to think that fighting with ballots is much the same as fighting with bullets. Disregarding a difference that seems to us to be more than academic, he concludes that the American people is in no position to criticize the Mexican people. It is not the first time that an anthropologist has failed to understand the politics of his own day. We have more respect for the opinion of the small boy who was asked by his teacher: "Now, Johnny, can you tell me what is raised in Mexico?" The bright boy replied promptly: "Aw go on, I know what you want me to say, but ma told me to cut out that rough stuff."

AMONG the items of misinformation appearing on the editorial page of the 'Morning Howl' we note the statement that "Great Britain has found an effective mode of stimulating production in her South African mines in the shape of a disguised bounty to producers". The stimulation is due, of course, directly to the fall in exchange whereby more shillings have to be paid for an ounce of gold; the cause lies as much in New York as in London. The article in which the misleading assertion appears is meant to support the proposed $10 excise-tax on manufactured gold under the terms of the McFadden bill. The chief objection made to this bill is that it is a piece of special legislation, in behalf of a relatively small industry. This, we must confess, is a valid objection, much as we may sympathize with the gold miner. Such legislation provokes log-rolling in Congress, after the fashion of the methods by which support is obtained for River and Harbor Bill appropriations and tariffs in favor of various domestic products. It has been suggested that a law be

passed forbidding the sale of gold by the Mint to manufacturers, but any such provision would be avoided by taking Federal Reserve notes and converting them into gold coin, which could then be melted into bullion. Another idea is to prohibit the use of gold in manufactures, thereby restricting its employment to monetary purposes. All such legislation is objectionable because it destroys the free market for gold, on which in the long run we must depend for a correction of the existing abnormal conditions. The problem is one that has world-wide implications; it is not local nor even national.

ON page 142 we give extracts from a speech made at Johannesburg by Mr. Samuel Evans, the chairman of the Crown Mines company. Mr. Evans is a man much respected for his sagacity and good sense. He stated that the premium on gold produced from January to May inclusive this year had averaged 21s. 1d. per ounce, which is equivalent to 25%. An ounce of gold is worth normally 84.95 shillings. The premium, he said, represented 7s. less than the increase in cost per ounce since 1913, which therefore must have been 28s., or $6.75, per ounce produced. White wages have increased 69% since 1915; the average earnings of European workers have risen 64.6%; stores cost 33% more, and other costs are 36% higher than five years ago. The purchasing power o gold in South Africa, however, has not fallen as rapidly as in England, where it is half what it was in 1914. If the commodity price of gold had remained as it was in 1896 the average cost of mining on the Rand would be, according to Mr. Evans, under 12s. per ton as against the actual average of 22¾s. last year and the higher figure this year. The banks of South Africa have been issuing paper money at an accelerating rate and they seem bent upon "plunging the country deeper into the paper-money bog". In this respect South Africa is no solitary sinner. The gold held by the 31 principal countries of the world is only two billion dollars more than before the War, whereas the pile of paper money is larger by 43¾ billions.

WE can think of no act of courage more unselfish or more splendid than to enter a burning or caving mine in an effort to save the life of fellow workmen The risk is not faced on the spur of the moment, it is taken knowingly and deliberately; it means entering a dark hole in the ground where the story of a valiant effort may be buried with the bodies of those in danger and their would-be rescuers, and even if successful there can be nothing of the spectacular in the performance; there is no glamor of heroic achievement before an admiring crowd; often there is less chance of saving the lives of the imperiled ones than of losing those of the men that seek to aid them. It is an everlasting tribute to the miner that invariably when the emergency arises someone quietly undertakes the task of rescue. On the occasion of the international first-aid and mine-rescue contest to be held at Denver next September Dr. Frederick G. Cottrell, Director of the U. S. Bureau of Mines, on behalf of the Joseph A. Holmes Safety Association, will present gold medals and appropriate diplomas to four miners, and to the nearest surviving relatives of three others, who lost their lives in their effort to succor fellow-workmen. Mr. John L. Boardman, wearing an oxygen helmet, single-handed saved three men who had been overcome by gas from a fire in the West Colusa mine at Butte. Mr. Daniel Bionvitch jeopardized his own life by running his electric locomotive three times into the fire-zone at the Balkan mine in Bewalik, Minnesota, on each trip bringing out men whose lives were imperiled. At the Gold Hunter mine, near Mullan, Idaho, two miners were entombed as a result of a fall of ground. Mr. James Collins and Mr. James Dillmark, while endeavoring to help their comrades, were themselves caught by caving rock. They were later rescued although buried to the shoulders in broken ore. Messrs. Michael Conroy, Peter Sheridan, and James D. Moore particularly distinguished themselves in the terrible fire in the Speculator mine at Butte, in which they and 168 other miners lost their lives. The heroism of these three, however, stood out particularly, and their relatives are now to receive the honors that the men so unselfishly earned. The other men named will receive their medals in person. There are doubtless others both living and dead who under similar circumstances have performed deeds equally worthy. To them, let us hope, has come reward no less than to these whose heroism is to have a public recognition so richly deserved.

Metal Quotations

Great is truth and it will prevail, says a Latin proverb. We are amused to read the naive and belated confession of the 'Engineering and Mining Journal', in an editorial appearing in the issue of July 10, acknowledging that its metal quotations are merely approximations, of a character unsatisfactory even to its editor. For many years we have insisted upon the absurdity of mine-operators selling their ore and basing their wage-scale on the guess of a trade-paper in New York. Heretofore our contemporary has insisted upon the essential accuracy of its weekly guesses and it has suited the metal-buyers to accept its figures in the settlement of purchases from the smaller mining companies. The big ones, of course, avoided doing anything so foolish; they sold their metal through their own agencies. We have insisted again and again that the price at which copper, for example, is sold by a given individual or company may be ascertained definitely, but the average price at which a variable number of producers at varying intervals sell varying quantities of copper cannot be determined by anybody, unless *all* the transactions are known accurately, that is, a true weighted average has never been available to the trade. Only recently the editor of the 'Journal', anxious to prove that the papers of the McGraw-Hill agglomeration were not "in collusion" as to metal prices, showed what discrepant quotations they have been giving their readers. Of course, he proved too much; we hastened to excuse the 'Journal' from the charge of collusion and we absolved it also of the imputation of accuracy. So now

the editor rounds the incident by confessing his quotations to be "unsatisfactory" because they are mere "approximations" of the truth. He deserves credit for his frankness; in future there can be no misunderstanding as to the real character of the 'Journal's' metal prices. There will be no excuse for relying upon them; there never was. Sellers of ore can, and should, settle on the price that the smelter obtains for the metal in their ore; miners can, and should, base their sliding scale of wages upon the price that the company obtains for its metal for the month; as the metal is sold in advance, there need be no trouble in adopting such an arrangement. It is a clear gain to the industry that a fake should have been acknowledged at last.

Smelting Lead-Zinc Ores

Last week we published a paper by Mr. Gilbert Rigg in which he detailed recent improvements in the practice of roasting and smelting lead-zinc ore from Broken Hill at the Port Pirie plant. A number of well known metallurgists associated with smelting enterprises in other countries joined in the discussion of the paper and their remarks, together with an informal reply by Mr. Rigg, appear in the June bulletin of the Institution of Mining and Metallurgy. Mr. Rigg has recently completed a tour of the United States in the course of which he visited a number of the big smelters, and his comments are doubtless enriched by his observations in this country. The discussion therefore brought together ideas on modern practice in lead smelting from many parts of the world. Mr. S. J. Speak described briefly the blast-furnace smelting of an oxidized lead-zinc ore in northern Rhodesia. The furnaces were run in a decidedly unusual way. The charge-column had a height of only 12 feet above the tuyeres, the blast-pressure was maintained at less than 8 ounces, and the slag, which averaged 20.5% zinc oxide, contained 43% ferrous oxide and was extremely low in lime, the average analysis for lime and magnesia combined being only 2 to 3%. The capacity of the furnace was but two tons per square foot of tuyere-area, and the slag usually contained 7% lead. Obviously this remarkably high lead content suggests faulty reduction and the question arises why a higher charge-column and a correspondingly increased blast-pressure could not be used. Moreover, the necessity for a moderate proportion of lime to obtain good reduction is generally recognized. A query from Mr. Rigg, as to whether any attempt had been made to determine the particular form of the lead in the slag, was answered in the negative. Without intending any reflection on those in charge of the plant in Rhodesia, there appears to be a fruitful field for painstaking and systematic experimental work with an excellent chance for revising the practice in such a way as to effect a decided decrease in the amount of lead in the slag; but final criticism would be imprudent, as the economic conditions may have been such as to warrant the procedure described. While on the face of it the metallurgy appears to be bad, it is certainly no more reprehensible than, for instance, the practice formerly in vogue at Port Pirie of feeding old slag, in proportion ranging from one to two times the remainder of the charge, as a sort of physic to flush the zinky matte through the blast-furnace. The cost of quarrying this slag, the additional fuel required, the reduction in effective capacity of the furnaces, and the cost of the final disposal of the extra slag from the furnaces were obvious defects, and, as was later demonstrated, they were all unnecessary. The concensus of opinion was that a high zinc content in the sintered material causes trouble in the blast furnace only when the roast has not been effectual in reducing the total sulphur to a point considerably below what would be allowable were the zinc not prominent; in fact, the prime essential for the smooth operation of the furnaces, when the analysis shows more than 15 or 16% of zinc oxide, is the removal of the sulphur. At Port Pirie the sulphur in the sinter is kept at approximately 2.5%. In this connection Mr. J. C. Moulden pointed out that at Cockle Creek difficulty has always ensued if the silica content of the slag, containing 20 to 22% of zinc oxide, is allowed to rise above 20%. Mr. H. C. Lancaster injected a novel suggestion. He had noted that, whereas slags containing 15 or 16% of zinc oxide were generally conducive to trouble, slags running 30 and 32%, in his experience, had been quite fluid and exceptionally low in lead. He inferred that there might be a critical point in the neighborhood of 20% beyond which the difficulties incident to the presence of zinc diminished. Mr. C. O. Bannister was impressed with the possibilities opened up for an alternative method of beneficiating a lead-zinc ore. The trend of metallurgical development has been in the direction of making two exceptionally clean concentrates, one of lead and the other of zinc; this result, of course, being facilitated by the use of flotation and fine grinding; if, however, as seems probable, a lead concentrate containing a reasonable proportion of zinc can be smelted successfully and economically and the zinc afterward recovered from the slag, the older and more simple methods of concentration might be revived. Several schemes for de-zinking slag are available. At South Chicago two methods have been tried, namely, charging the slag in lumps, and feeding briquettes made of ground slag and pulverized fuel. The use of briquettes gives a higher extraction, but, of course, introduces a considerable extra expense. Blast-furnaces for de-zinking have been used in the United States and Germany, but the best success has been obtained in reverberatories, fed at the side. This last point is important because of the fact that the zinc-oxide fume is driven off before actual fusion occurs; accordingly the fuel-ratio and the operation must be regulated to avoid actual melting, or the recovery will be poor. Reverting to the roasting process, Mr. W. Dewar agreed with Mr. Rigg that the three principal considerations in any roasting operation are temperature, time, and ventilation or contact of the ore particles with the air; and that the three are complementary factors. In blast-roasting the third factor is emphasized and the time is consequently reduced. He

points out that the difficulty is to keep the charge from becoming hot enough to fuse before roasting is complete, and that this may be accomplished by the addition of limestone, iron oxide, and slag, and by damping the ore preliminary to the roasting process. Primarily, blast-roasting has the tremendous advantage of large capacity. Mr. Riggs' figures indicate that in 24 hours 270 pounds of sulphur is driven off per square foot of hearth-area as against only 5 pounds in a furnace of the superimposed-hearth type. However, the efficient utilization of Dwight & Lloyd machines or Huntington & Heberlein pots depends upon a careful study of the physical, no less than the chemical, characteristics of the material to be smelted. There seems to be a tendency, when a process has been developed to a point where good results are obtained, to subside to a rule-of-thumb practice. Perhaps also, metallurgists, like the rest of us, are prone to take up fads and to centre on them their entire attention while the more familiar methods suffer from neglect. Without advocating by any means a policy of metallurgical Bourbonism we venture to say that much may be gained by devoting more time, talent, and energy to scientific research in some of our supposedly perfected processes.

The Federal Trade Commission

We have received a copy of a speech delivered by Mr. William B. Colver, a member of the Federal Trade Commission, at Atlantic City on July 8. We note that he says that "the Commission has been created to aid in keeping the channel of the River of Commerce free from obstructions and the Ships of Commerce moving freely without undue interference, one with the other". He says that the spirit of the legislation under which the Commission was created is expressed by the phrase: "Unfair methods of competition in commerce are hereby declared unlawful," and he proceeds to expatiate on this text by saying: "This declaration means that in commerce there shall not be trickery or chicane; that there shall not be the rule of might as opposed to right; that unfairness, meanness, ruthlessness, and dishonesty have no place in American business." Which reminds us of Mr. Bryan's proposal to compel equality of punishment between the sexes in regard to infractions of the seventh commandment. However, if the Federal Trade Commission can help toward the much desired consummation of promoting clean and fair business methods all the way from New York to San Francisco, or from Cape Cod to Cape Nome, it will deserve, and obtain, the gratitude of all good citizens. We take an interest in Mr. Colver's remarks because we were present at, and even participated in, a recent hearing before the Federal Trade Commission in San Francisco when its representatives were taking evidence in the matter of the complaint against the Minerals Separation people. This slight experience of its methods and the reading of the voluminous record in this particularly interesting case prompt the remark that the procedure, like that of the courts in patent cases, seems curiously ill adapted to eliciting the truth. In the first place, counsel for Minerals Separation understands the affairs of his company thoroughly; he has himself testified that he is a director of the Minerals Separation North American Corporation, and a stockholder in that corporation, "or rather, a holder of voting-trust certificates". He holds the whip-hand over counsel on the other side, who do not understand the flotation controversy nearly as well, and are bent apparently on a general fishing expedition in the course of which they expect to catch some high-smelling game. The method is something like the old equity procedure termed a 'bill of discovery'. The respondents have had to submit to a search among their papers and an investigation of their correspondence such as must have proved extremely irritating. We would not spare that irritation, remembering the high-handed and inquisitorial methods that they themselves have adopted toward the operators of mines and mills, but we can readily see that the methods permitted under the law to the Federal Trade Commission are open to grave abuse. As the identity of the complainant and the period covered by the actions of which complaint is made are not disclosed to the respondents or to the public, it is impossible to appreciate how much or how little of the testimony is pertinent. One thing is sure, there will be an enormous mass of it to be digested by the members of the Commission before they can deliver a decision. The proceedings were started a year ago and the hearings began on April 7 last in New York. They are now being held in San Francisco, Salt Lake City, and Denver. Months must elapse before they are finished and more months before the record is corrected and revised for presentation to the Commission itself. A great deal of irrelevant matter has been put into the record, simply because it is impossible for the presiding officer, the Commissioner, to tell off-hand how much of it has a bearing on the issue. Opposing counsel engage in long and wordy debates, not to mention acrimonious squabbles, over points that seem quite immaterial. The proceedings in San Francisco, under the direction of Mr. Huston Thompson, seem to have been more orderly than they were in New York, so far as we can judge by the record, but even the Commissioner who presided here had to allow a wide latitude in regard to the discussions initiated by counsel on both sides. This does not impress the spectator as an efficient method of inquiry. It is, of course, an old-fashioned way of getting at the truth, but it is woefully clumsy. In so far as the inquiry runs parallel with the case now before the Court of Appeals at Philadelphia, it is regrettable, for the hearings before the Commission are quite unsuited to the ventilation of technical questions, apart from the unseemliness of traversing issues that are being tried elsewhere. The inquiry will, we expect, elicit ample evidence of the queer practices of the Minerals Separation people and we hope that it may lead to their being disciplined for any infraction of the Clayton act, if they have been guilty thereof, but it will, we fear, fail in loosening the blighting tentacles of that patent-exploiting agency.

The Price of Gold

The Editor:

Sir—In your issue of June 26, Mr. A. Moline says that the conclusions in my letter appearing in your issue of March 6 are based on a misconception. He states that, "when gold was quoted in London at £6 per ounce it meant that for an ounce of gold you could get six British notes or a negotiable instrument of equal face value, or the equivalent value in other goods, but six sovereigns could not be got for an ounce of gold under any conceivable conditions." He then goes on to show that if one could get six sovereigns for an ounce of gold they would be immediately melted down, making an ounce and a half of gold, for which one would proceed to obtain nine sovereigns, and so on *ad lib*.

The weak points in Mr. Moline's argument are:

1. That in Great Britain it is illegal to mutilate or destroy sovereigns. When the price of gold rose in England during the War, the immediate effect was the violation of the law, by certain of the public, in melting down sovereigns. The British government at once took steps to prevent this.

2. A British note, or a negotiable instrument of equal face-value, is a promise to pay gold, in the ultimate. It is quite conceivable that if a person must have gold for an industrial purpose, he should give a promise to pay six sovereigns for an ounce of gold at some future time, and this was actually the case.

In support of what I have said, I would recommend Mr. Moline and others to read and re-read the masterly address delivered by Mr. Francis A. Govett at the annual meeting of the Ivanhoe Gold Corporation, part of which was published in your issue of June 5. If you will allow me I shall quote Mr. Govett as follows: "For six years past, except nominally, the convertibility has been suspended, and, except in very small amounts, you could not get gold for notes; but the credit of the note—the currency, either Bradbury or Bank of England—has not been damaged to the extent of a penny piece. The fact that prices have risen does not mean depreciation of the currency; nor is currency inflated; currency is not inflated until the currency in circulation is in excess of the demand. At the present time more people with higher wages have been competing for scarcer commodities, more currency has been required, and paper internally has not depreciated in gold. Try it for yourselves. You can get probably 50 or 100 sovereigns from the bank, once at any rate, without being followed by a detective; go and see if you can buy more commodities with your hundred golden sovereigns than you can with a hundred Bradburys. You cannot do it unless you sell your gold to an illicit buyer who proposes to melt it down."

In view of this I regret that I cannot accept most of the five basic facts laid down by Mr. Moline. If No. 5 is correct, that "bar gold of specific fineness and sovereigns or other gold coin are interchangeable on a fixed arithmetic basis only", then why should an illicit buyer of sovereigns want to melt them down? No. 4, which states, "The price is expressed in the unit of measurement in current use, and just now that is paper currency, not metallic currency," is sufficiently well answered by the quotation from Mr. Govett.

THOS. FRENCH

Guelph, Ontario, July 8.

[Mr. French is, we think, inconsistent. He takes issue with Mr. Moline when he says that "six sovereigns could not be got for an ounce of gold under any conceivable conditions" and then immediately quotes Mr. Govett as saying "For six years past, except nominally, the convertibility [of notes] has been suspended. . ." Messrs. Moline and Govett in substance concur, although Mr. French apparently does not think so.—EDITOR.]

An Interesting Experiment

The Editor:

Sir—The results of the experiment described in the communication from Charles W. Gardner, which appeared in your issue of June 26, are "remarkable and unexpected" if the conditions of the experiment were exactly as described, namely that the outer end of the gold strip was above the level of the quicksilver in the vial. By substituting a lamp-wick for the strip of gold and water or oil for the quicksilver the forces involved remain the same. When the outer end of the wick is below the level of the liquid in the vial, the liquid will drip from the outer end of the wick; in other words, the wick will act like a siphon. Quicksilver wets gold just as oil wets a lamp-wick, and the so-called capillary attraction causes it to climb up. When it reaches the top and spreads over to the downward-hanging segment gravity helps to pull it down, so it accumulates at the lower end and finally drops off, drop by drop.

The statement that in 30 days 1.9 grains of gold had been "dissolved" by the quicksilver needs further explanation. It cannot be literally true, for the solubility of gold in mercury is very low, certainly not over 0.1% at ordinary room temperatures. The exact quantity of quicksilver used is not given but was apparently about 500 grains, which would suffice to dissolve only half a

grain of gold. Gold dissolves mercury, however, forming one or more intermetallic compounds, as I have described in some detail in Vol. XXXVII of the Trans. A. I. M. E. This appears in the form of distinct crystals, first described by A. H. Chester in 1878, which seem to become detached and float about in the quicksilver. It is apparently for some such reason as this that the published data as to the solubility of gold in quicksilver vary quite widely, for Dudley found that the apparently dissolved gold could be partly removed by filtering the quicksilver, and my own results confirmed this. Our results indicated that the solubility of gold in quicksilver at 20°C. is not over 0.06%, and may be much less, the figure given representing our limitations as to filtering media, rather than the actual solubility.

THOMAS T. READ.

Washington, July 6.

The Editor:

Sir—The experiment described by Mr. Chas. W. Gardner in your issue of June 26 may be explained as follows:

The affinity of gold for mercury caused the gold bar to act like a wick, up to the point of saturation. Upon saturation, gravity caused the mercury to accumulate on the lower outer end of the bar and drops to form. When the first drop began to form the forces acting were gravity, amalgamation, resistance of the gold to passage of mercury, and the surface-tension of mercury: that in the vial tending to force mercury up the bar and that enveloping the drop tending to force mercury back along the bar toward the vial. The resultant coincided with that of gravity.

In the second experiment, conducted under water, there was a hydrostatic head in the vial and on the outer end of the bar, which exactly balance. In the vial its sides were wetted by water but the convex surface of the mercury was not wetted. Consequently the surface-tension of the water in contact with the mercury caused a downward pressure, which the mercury transmitted along the bar. On the outer end of the bar and acting against the tendency toward the growth of a drop, there was likewise an unwetted mercury surface enveloped in a skin of water, the tension in which, per unit of surface, was greater than the surface-tension on the mercury in the vial, but acting in the opposite direction. This minute unbalanced force acting opposite to the resultant of all the forces in the first experiment sufficed to prevent the discharge of mercury from the vial in the second experiment.

If it be argued that this force is insufficient to suppress the formation of the mercury drop, one need but consider that 168 hours were required to form the first complete drop; which proves that the resultant of the unbalanced forces in the first experiment, as measured by its effect, was exceedingly minute; therefore a like minute force acting in the opposite direction would restore equilibrium. In the second experiment this is exactly what happened.

Proof of this explanation can be had if a third experiment, performed in water, to which is added a liquid to sufficiently diminish its surface-tension, as for instance alcohol, yields results as in air.

MARTIN SCHWERIN.

Cave-in-Rock, Illinois, July 6.

Stiff Hats for Miners

The use of helmets during the War has accentuated interest in the use of stiff hats in mines to protect the miners against falling rock. About 40% of the accidents in mines result from this cause. A large number of these accidents could be prevented if the miners wore stiff hats or helmets. The use of protective devices for the head in mines is not new, for they have been in use for many years in Europe and in the Lake Superior district in the United States. In practically all of the mining districts in Europe stiff hats of some kind are required by the managers of the mines. George S. Rice, chief mining engineer of the Bureau of Mines, reports that in Germany, Belgium, and France stiff hats made of papier mache or felt rosin are in use. Similar hats are generally employed in the Lake Superior district. In building the subways of New York and Philadelphia it was the practice of engineers and workers to let the hair grow long and to wear a close fitting cap or felt hat. In Germany the hats are high, like the military helmets, whereas in France and Belgium they fit more closely to the crown. In England both kinds are worn. As a rule the miners use soft padded caps, but in Yorkshire many of the miners use tight-fitting caps of sole-leather made on a jockey pattern with the seam forming a little ridge down the middle of the cap. These hats are useful in low thin beds of coal, as in crawling one is likely to strike his head on a sharp piece of rock or on a timber. It must be admitted such hats do not stick on well, though this is usually due to their not being specially fitted. The German hat is unsuited to an American-shaped head.

It is interesting to note that on the Continent tight cotton caps are generally worn over the hair and under the hard hat. This is a measure for cleanliness. In low beds of coal where much crawling on hands and knees is necessary the dirt and coal dust sift down, making the miner black and dirty. In metal mines stiff hats are of especial use in shaft-work; also in raises or high stopes. A small fragment of rock falling some distance either down a shaft or raise would kill a man if it struck him squarely on the head. A stiff hat or helmet may protect him and save his life. At a station in a shaft where men are loading a cage or skip, some kind of adequate head protector should be compulsory. A head-protecting cap which is also a good insulator should be worn where there is danger of striking one's head against a wire carrying an electric current. As a rule, miners are more willing to take chances than to wear a hat that is cumbersome or hot. The European miners have become so accustomed to the use of a head-protecting device that wearing one has become second nature to them. It would be desirable if stiff hats were in more general use in our mines.

Problems in Mine Ventilation

By WALTER S. WEEKS

We have completed our discussion of the method of determining mine-resistance. When the mine-resistance has been calculated, a fan can be specified that will be suited to the work.

Another phase of the problem of ventilation is to predict the amount of air that a given fan will circulate if the resistance is known. This type of problem occurs in tunnel-driving where the air is forced to the breast through an ever increasing length of pipe. We should like to know how much air the fan will deliver at different periods during the advance of the tunnel.

Through the kind permission of the American Blower Co. I am able to use its chart showing the drop in pressure in air-pipe. See Fig. 1.

Let us assume that a tunnel is to be ventilated with a 16-in. pipe. The tunnel is to be driven 4000 ft. The static-pressure characteristic of the fan when operated at the rated speed is shown in Fig. 2, curve *A*. How much air will this fan deliver when the tunnel is in 2000 ft. and how much when it is in 4000 ft? From the pipe-chart we read the drop in pressure in a 16-in. pipe per 100 ft. with amounts of air from 0 to 6000 cu. ft. per minute in circulation. The drop in pressure for other lengths may be easily calculated, as it is proportional to the length. The resistance offered by the tunnel to the returning air after it leaves the pipe is generally negligible because of the low velocity.

We may plot on the chart with the fan characteristic the pipe characteristic that shows the drop in pressure in a given length with varying amounts of air. In Fig. 2, *B* is the pipe characteristic for 2000 ft. and *C*, for 4000 ft. The point where a pipe characteristic and a fan characteristic intersect shows the pressure and quantity at which the system reaches equilibrium. The quantity that will be delivered may be read vertically below the point of intersection. The same method might be used to determine how much air a large fan would circulate in a mine but the computation would be tedious.

Effect of Variation in Speed. It is often desirable to have the pressure-volume characteristics of a fan for several different speeds. If the characteristic at one speed is available others may be computed.

In Fig. 3, *A* is the characteristic of a fan running at 1000 r.p.m. Let us determine the characteristic at 2000 r.p.m. We know that if we double the speed we double the air and obtain four times the pressure if the conditions are unchanged. Select any point on the curve *A* and we obtain the combination of pressure and volume which occurs when the orifice is open a certain amount. If we were running a test at double the speed, at some time we should have this same gate-opening. When that happened the fan would deliver twice the air, at four times the pressure, that it did at 1000 r.p.m. So if we select any point on the 1000-r.p.m. characteristic and multiply the quantity by two and the pressure by four we shall obtain a point on the 2000-r.p.m. characteristic. Curve *B* is the 2000-r.p.m. characteristic constructed from curve *A*. The density of the air is assumed to be the same in both cases. By plotting a number of curves at different speeds on the same sheet as used for the pipe characteristics, a complete knowledge of a tunnel-ventilating system may be gained.

Operation of Fans in Series. When the limiting speed of a fan is reached and the pressure produced is inadequate, the pressure may be increased by connecting fans in series; that is, the discharge of one fan is piped into the suction of another. Any number of fans may be operated in series. The same result may be obtained by placing the fans at intervals along the line. If the fans are close together a high pressure is produced at the entrance of the pipe. Accordingly if the pipe-line is full of leaks much air will be lost.

Fig. 4, *A* and Fig. 5 are the characteristics of two fans that are to be operated in series. To determine the result of such a scheme we plot a combined characteristic curve by adding the water-gauge readings produced by the two fans with the same given quantity. Curve *B*, Fig. 4, is the combined characteristic. Whichever fan is receiving air from the other produces a slightly higher water-gauge than when running alone because it does not have to accelerate the air at the inlet, and because it is handling air of a higher density, but consideration of the extremely slight difference is unnecessary.

The smaller fan will be a help where the quantity is less than 30,000 cu. ft. per minute. At that point it is circulating its maximum amount of air and the static pressure produced is zero. If more air than this is circulated the smaller fan will be a hindrance because a part of the pressure produced by the larger fan will be consumed in forcing the air through the smaller, and so the two in series would deliver less air than the larger one alone. The combined characteristic curve may be treated as the curve of a single fan.

The Operations of Fans in Parallel. The study of the operation of fans in parallel is somewhat more complicated. Let us assume for the purpose of exposition that conditions are as shown in Fig. 6. Fan No. 1 blows air through 300 ft. of 12-in. pipe to the point where 200 ft. of 12-in. pipe brings the air from fan No. 2. The ducts unite at *B* and the air is then conducted through 500 ft. of 18-in. pipe. In Fig. 7, curve *A* is the characteristic of fan No. 1 and in Fig. 8, curve *C* is the characteristic of fan No. 2. The problem is to determine the load that each fan will assume. First plot the pipe characteristic

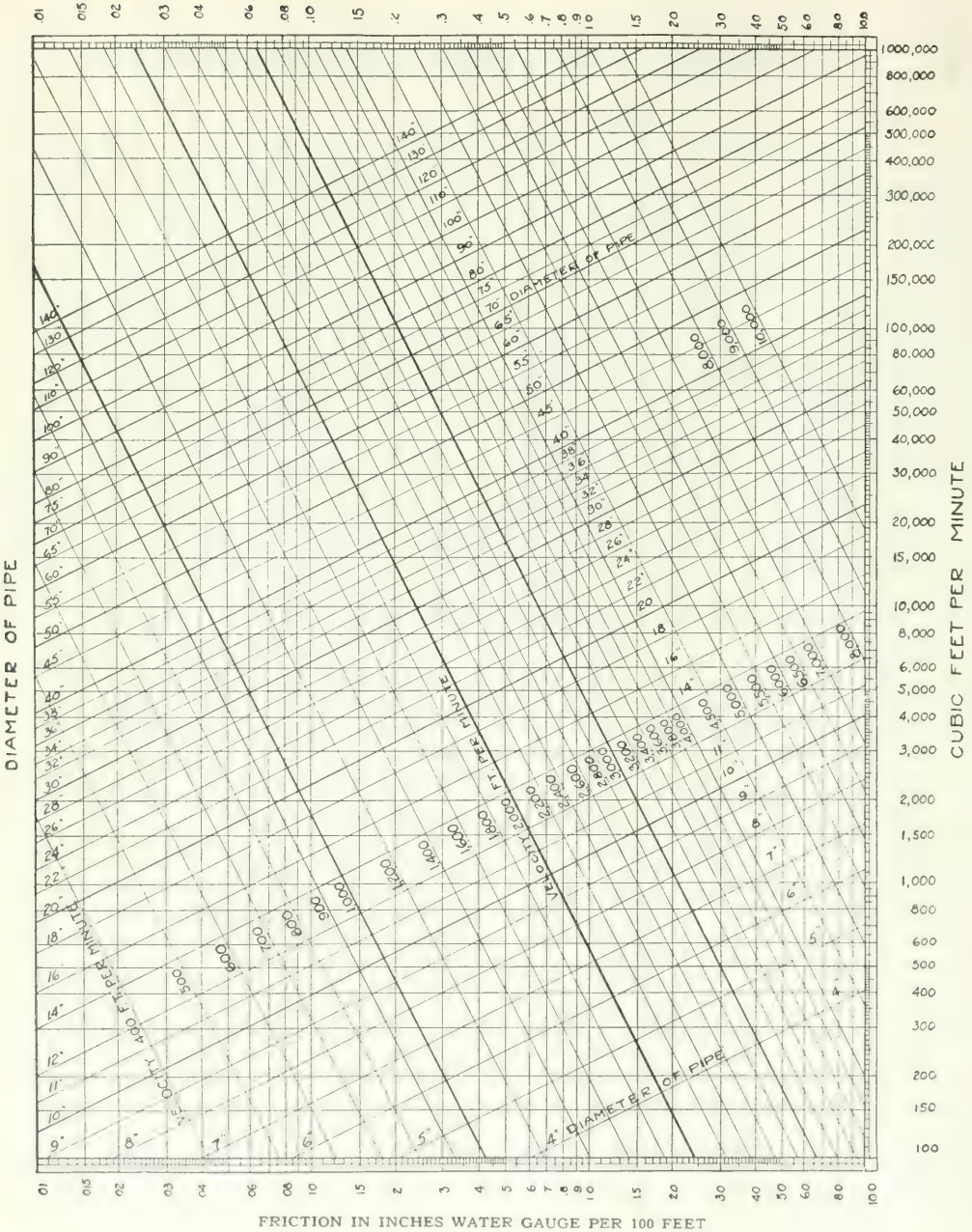

DIAMETER OF PIPE
CUBIC FEET PER MINUTE
FRICTION IN INCHES WATER GAUGE PER 100 FEET
VELOCITY IN FEET PER MINUTE
DIAMETER OF PIPE
4" DIAMETER OF PIPE

FIG. 1. CHART SHOWING DROP IN PRESSURE IN PIPES

of the 18 in. pipe on either chart. It is shown in Fig. 8, curve *E*.

Next on the chart for fan No. 1 plot the characteristic of its pipe up to the junction. Curve *B* in Fig. 7 is this curve. Then on the chart of No. 2 fan plot its pipe characteristic. This is *D* in Fig. 8. The pressure at *B* (Fig. 6) will be determined by the total quantity of air that flows through the 18-in. pipe. The air that flows from

either fan must contain, when it reaches *B*, a pressure equal to the pressure at *B* so the amount of static pressure that can be consumed in the pipe from either fan before reaching *B* will be the static pressure produced by the fan when the air is flowing, minus the pressure at *B*.

Assume the total amount of air and 'pick-off' with a pair of dividers the pressure at *B* from curve *E*, Fig. 8.

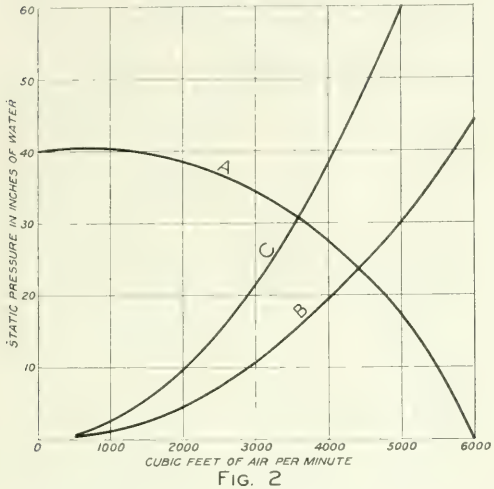


FIG. 2

Place one point of the dividers on curve *C* with the other point vertically beneath. Keep the first point on the fan characteristic and move the dividers along until the other touches curve *D*. Read the amount of air that the fan will then give. This amount subtracted from the total amount assumed must be what the other fan will deliver.

Turning now to Fig. 7, without altering the dividers, place one point on the intersection of curve *A* and the

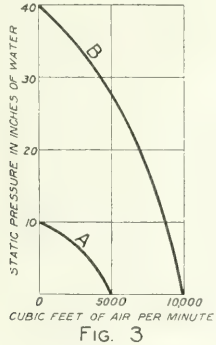


FIG. 3

quantity line just computed for fan No. 1. If, when the other point is vertically beneath the first, it does not fall on curve *B* our first assumption of the total air was incorrect and we must make another and repeat the operation. If the point does fall on curve *B* the assumption was correct and the division of the air will be as computed.

EXAMPLE. Assume 4050 cu. ft. per minute as the total air. To drive this through the 18-in. pipe the pressure at *B* must be 2.6 in. We have then available for the pipe from No. 2 fan the water-gauge that it will produce minus 2.6 in. When 1750 cu. ft. is flowing from fan No. 2 the drop in pressure in the 12-in. pipe is 1.5 in. With this amount of air the fan produces a water-gauge of 4.1 in. so there will be left 2.6 in. at *B*. The difference between 4050 and 1750 is 2300, or the amount that the other fan will deliver. When 2300 cu. ft. is flowing from fan No. 1 the drop in the 12-in. pipe from fan No. 1 is 3.9 in. The

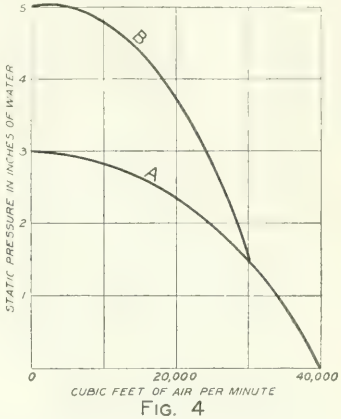


FIG. 4

fan produces 6.5 in. with this quantity, so the air when it reaches *B* will have the 2.6 in. of static pressure that is required. Of course it took several assumptions to solve this example.

THE ECONOMIC SIZE OF AIRWAYS. The cost of driving air through a duct depends to a large extent upon the resistance offered by the duct. In selecting the best cross-section for an airway, the one having the smallest ratio of perimeter to area should be selected if possible. The reason for this may be seen by inspecting the formula for friction. Obviously the duct should be made as smooth as feasible. After the shape of the duct is decided upon, it becomes necessary to fix upon the size. In this matter the cost of transmitting the air is the arbiter. The

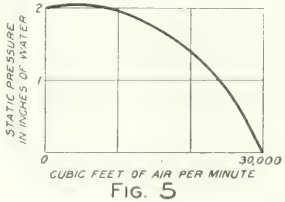


FIG. 5

question may be best discussed by using a concrete case.

Let us assume that we are to sink a circular air-shaft 1000 ft. to connect with the mine-workings. The shaft is to be in use for twelve years. It costs $20 per cubic yard of excavation and 100,000 cu. ft. of air per minute is to pass through the shaft. The efficiency of the fan and motor is 60%. The coefficient for friction is assumed to be 0.000,000,007,3. Power costs $150 per horse-power-

*Table I—Sinking-Fund Table

Time At end of year	Rate of interest 2%	3%	4%	5%	6%	7%	8%
1st	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2d	2.02	2.03	2.04	2.05	2.06	2.07	2.08
3d	3.06	3.09	3.12	3.15	3.18	3.21	3.25
4th	4.12	4.18	4.25	4.31	4.37	4.44	4.51
5th	5.20	5.31	5.42	5.52	5.64	5.75	5.87
6th	6.31	6.47	6.63	6.80	6.98	7.15	7.34
7th	7.43	7.66	7.90	8.14	8.39	8.65	8.92
8th	8.58	8.89	9.21	9.55	9.90	10.26	10.64
9th	9.75	10.16	10.58	11.03	11.49	11.98	12.49
10th	10.95	11.46	12.01	12.57	13.18	13.82	14.49
11th	12.17	12.81	13.49	14.21	14.97	15.78	16.65
12th	13.41	14.19	15.03	15.91	16.87	17.89	18.98
13th	14.68	15.62	16.63	17.71	18.88	20.14	21.50
14th	15.97	17.09	18.29	19.60	21.01	22.55	24.22
15th	17.29	18.60	20.02	21.58	23.27	25.13	27.15
16th	18.64	20.16	21.82	23.65	25.67	27.89	30.33
17th	20.01	21.76	23.70	25.84	28.21	30.84	33.75
18th	21.41	23.42	25.66	28.13	30.90	34.00	37.45
19th	22.84	25.12	27.68	30.54	33.76	37.38	41.45
20th	24.30	26.87	29.79	33.06	36.78	41.00	45.76
21st	25.78	28.68	31.98	35.72	39.99	44.86	50.43
22d	27.30	30.54	34.26	38.50	43.39	49.01	55.46
23d	28.84	32.46	36.63	41.43	46.99	53.44	60.90
24th	30.42	34.43	39.10	44.50	50.81	58.18	66.77
25th	32.03	36.46	41.66	47.72	54.86	63.25	73.11
26th	33.67	38.56	44.33	51.11	59.15	68.68	79.96
27th	35.34	40.71	47.10	54.66	63.70	74.48	87.35
28th	37.05	42.93	49.98	58.39	68.52	80.70	95.34
29th	38.79	45.22	52.98	62.31	73.64	87.35	103.97
30th	40.57	47.58	56.10	66.43	79.05	94.46	113.29
31st	42.38	50.01	59.34	70.75	84.80	102.07	123.35
32d	44.23	52.51	62.72	75.29	90.88	110.22	134.22
33d	46.11	55.08	66.23	80.05	97.34	118.93	145.96
34th	48.03	57.73	69.88	85.05	104.18	128.26	158.63
35th	50.00	60.46	73.67	90.31	111.43	138.24	172.32
36th	51.99	63.28	77.62	95.82	119.11	148.91	187.11
37th	54.03	66.18	81.72	101.61	127.26	160.34	203.08
38th	56.11	69.16	85.99	107.69	135.90	172.56	220.33
39th	58.24	72.24	90.43	114.08	145.05	185.64	238.95
40th	60.40	75.40	95.05	120.78	154.75	199.63	259.07
41st	62.61	78.67	99.85	127.82	165.04	214.61	280.79
42d	64.86	82.03	104.84	135.21	175.94	230.63	304.26
43d	67.16	85.49	110.04	142.97	187.50	247.78	329.60
44th	69.50	89.05	115.44	151.12	199.75	266.12	356.97
45th	71.89	92.72	121.06	159.68	212.73	285.75	386.52
46th	74.33	96.51	126.90	168.66	226.50	306.75	418.44
47th	76.82	100.40	132.98	178.10	241.09	329.22	452.92
48th	79.35	104.41	139.30	188.00	256.55	353.27	490.15
49th	81.94	108.55	145.87	198.40	272.94	379.00	530.37
50th	84.58	112.80	152.70	209.32	290.32	406.54	573.80

*From Trans. A. I. M. E., Vol. XLI, Page 533.

Table No. 2. Data on Fans

No.	Outlet velocity	Speed r.p.m.	Mechanical efficiency	Horse-power	Price
1	4200	352	67.0	120	$1424
2	3500	308	65.5	115	1712
3	3000	276	64.5	111	2024
4	2580	254	60.0	116	2432

Table No. 3. Yearly Charges Against Fans

No.	Capital	Power	Total
1	$421	$19,950	$20,371
2	456	19,200	19,656
3	495	18,450	18,945
4	545	19,350	19,895

year. What should be the size of the shaft to transmit the air most economically?

Let us consider yearly charges. There will be two types of charges, namely, capital and operating. In the capital charge there will be interest and amortization. The money invested in the shaft will carry, let us say, an interest rate of 6%. Assuming that safe bank interest is 5%, an amount must be charged against the shaft each year, which, if placed in the bank at the end of each year, at compound interest, will at the end of twelve years equal the cost of the shaft. The only operating charge that varies with the size of the shaft is that for power so this alone must be considered in this group. We must now take a series of diameters and determine the yearly capital charge and the yearly operating charge. The sum of these will constitute the total yearly charge for transmitting the air. If we plot curves with the various shaft-diameters as abscissae we can determine which diameter will be the cheapest. To illustrate the method of making the calculation I shall give the computation for an 8-ft. shaft.

An 8-ft. shaft 1000 ft. deep will have a volume of 1861 cu. yd. Its cost at $20 per cubic yard will be $37,220. The yearly interest charge at 6% will be $2233. To figure the amortization we must have a sinking-fund table. Table No. 1 gives the amount which will accumulate in any number of years, if one dollar is placed in the bank at the end of each year with interest compounded annually.

One dollar put aside each year at 5% will according to the table amount to $15.91. In order to have $37,220 at the end of twelve years we must put aside at the end of each year

$$\frac{37,220}{15.91} = \$2339$$

The total yearly capital charge will be

$$\$2233 + \$2339 = \$4572$$

The amortization charge will be the cost of the shaft multiplied by $\frac{1}{15.91}$ or 6.29%.

The total yearly capital charge then will be 12.29% of the cost of the shaft.

The drop in pressure in the shaft computed with the friction formula is 2.78 in. of water or 14.46 lb. per sq. ft. The horse-power, assuming a 60% fan efficiency, is

$$\frac{14.46 \times 100,000}{0.6 \times 33,000} = 73$$

At $150 per year 73 hp. will cost $10,950.

The total cost for transmitting the air will be

$$\$4572 + \$10,950 = \$15,522$$

Such a calculation must be made for a sufficient number of diameters to determine which will be the most economical. The results for this particular problem are plotted in Fig. 9. The curve for total yearly cost is lowest with a 10-ft. shaft. So this will be selected. It will cost $10,744 per year to transmit the air through the shaft. If an 8-ft. shaft were selected by guess it would cost $15,522 per year and the owners during the twelve years that the shaft is to be used would lose, unnecessarily, about $57,000. This method of determining the cheapest airway should be applied to the pipes in tunnel ventilation as well as to mine-openings.

THE ECONOMIC SIZE OF FAN. I shall discuss the selection of a fan by means of an example. The shaft which we have selected connects with a mine. We have apportioned the 100,000 cu. ft. to the mine-workings and we have calculated the mine-resistance exclusive of the air-shaft and found it to be 1.22 in. The resistance of the shaft is 2.78 in., so the total mine-resistance is 4 in., and when 100,000 cu. ft. is flowing through the mine a water-gauge at the collar of the shaft would read 4 in. The area of a 10-ft. circular shaft is 78.5 sq. ft., so the velocity of the air in the shaft will be 1275 ft. per minute. We decide upon the type and make of the fan and then ask the manufacturer to submit a list of different sizes which will give 100,000 cu. ft. of air per minute at a

static pressure of 4 in., and at an outlet velocity greater than 1275 ft. per minute. The list that we receive is shown in Table No. 2. The size of the fan increases with the manufacturer's number. We are told that No. 1 fan is operating at the high point on the efficiency curve. Any one of these fans operating at the speed stated will deliver the prescribed amount of air at the designated pressure.

Let us first see how this table illustrates some of the

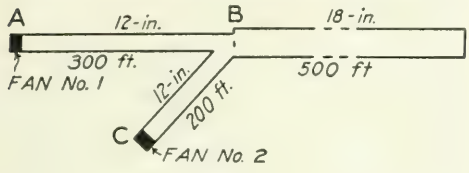


FIG. 6

principles that we have learned. No. 1 fan is operating at the peak of the efficiency curve, hence the ratio of static to velocity that is shown here will indicate to us the ratio at which this type of fan is most efficient. The outlet velocity is 4200 ft. per minute, so the velocity-pressure is $\left(\frac{4200}{4000}\right)^2 \times 1$ or 1.1 in. of water. The ratio of static to velocity is $\frac{4}{1.1}$ or 3.64. The larger fans, since they have larger discharge-openings, will have a smaller outlet-velocity with 100,000 cu. ft. of air. Since the static pressure in all cases is 4 in., the ratio of static to velocity in-

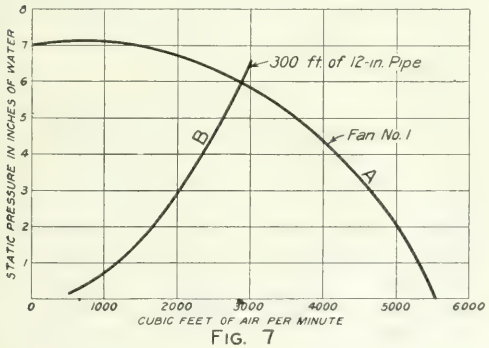


FIG. 7

creases with the size of the fan and so we should assume that the mechanical efficiency would decrease. The table shows this to be the case.

The table states that the No. 1 fan requires 120 hp. This should be checked. The velocity-pressure is 1.1 in. and the static pressure is 4 in., so the total pressure is 5.1 inches.

$$\text{Hp.} = \frac{5.1 \times 5.2 \times 100{,}000}{33{,}000 \times 0.67} = 120$$

The ratio $\frac{5.2}{33{,}000}$ always appears in this type of calculation.

The quotient is 6350. A person used to working such problems would at once express this equation for slide-rule computation thus:

$$\text{Hp.} = \frac{5.1 \times 100{,}000}{6350 \times 0.67}$$

In the calculation of velocity-heads a slide-rule should be used on which the top-scale figures are the squares of those on the lower scale. Using the outlet velocity for No. 1 fan as an illustration I will show how the velocity-pressure in inches of water is quickly determined.

The velocity-pressure in inches of water is $\left(\frac{4200}{4000}\right)^2 \times 1$

Let V. P. = velocity-pressure in inches of water

Then, $\sqrt{\text{V. P.}} = \frac{4200}{4000}$

On the lower scale of the rule divide 4200 by 4000. The

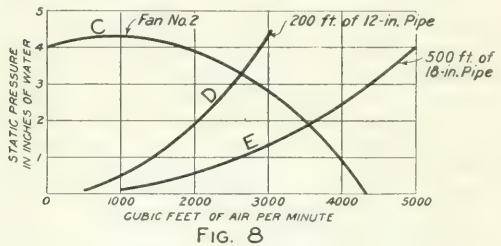


FIG. 8

result is the square root of the velocity-pressure so the velocity-pressure is read directly on the top scale of the rule.

To return to the fans, the other horse-powers may be computed in the manner shown. The prices given are those of the fans delivered at the mine. Our next move is to consult the dealer in motors. We are informed that a 150-hp. 3-phase induction motor will cost, with belt, $2000 at the mine. Its mechanical efficiency is 91% in

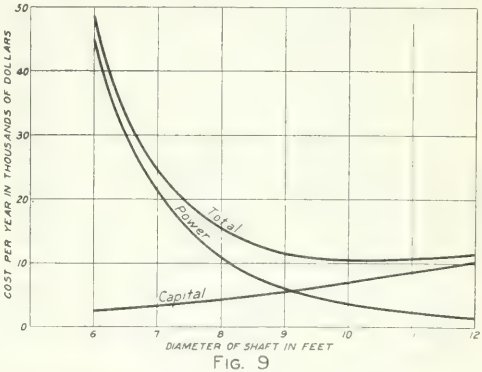


FIG. 9

the range from three-quarters to full load. We are now in a position to select the fan in the same way in which we selected the proper size of airway. I shall make the calculation on No. 1 fan to illustrate.

The cost of fan and motor is $3424.

The yearly capital charge is 12.3% of this, or $421.

Using an efficiency of 90% for the motor and belt the horse-power required will be $\frac{120}{0.9} = 133$.

133 hp. at $150 per year costs $19,950.

The total yearly charge is then $20.371.

Table No. 3 shows the yearly charges on all of the fans. Evidently No. 3 fan will do the work most cheaply, but how is it that a fan with a mechanical efficiency of 64.5% will do the work more cheaply than No. 1 fan that has a mechanical efficiency of 67%? The reason is this: No. 1 is developing a total pressure of 5.1 in. of water while No. 3 is developing a total pressure of only 4.56 in.; so in spite of the fact that No. 3 has the lower mechanical efficiency, the power required to run it is lower. The speed of the air entering the mine is 1275 ft. per minute, which corresponds to 0.1 in. of water. The total head actually required for the mine is 4.1 in. If we could have all the conditions fulfilled and at the same time get the highest mechanical efficiency it would be ideal, but we cannot. As we go to the larger fans the velocity-pressure approaches that demanded by the mine, but as the outlet-velocity decreases, the ratio of static to velocity departs more and more from 3.64, so the mechanical efficiency decreases. After we go beyond No. 3 fan the increase in power due to the decrease in mechanical efficiency more than offsets the power saved by the lower velocity-pressure and the power to run the fan increases with the size.

If the mine resistance is increased by the extension of the workings the speed of the fan may be increased to produce a higher pressure. If the same amount of air is circulated, the ratio of static to velocity will be still higher and so the mechanical efficiency will be lower.

The velocity-pressure in the air as it leaves the fan is 0.56 in. The velocity-pressure in the shaft is 0.1 in. Unless we can recover this by a gradually expanding duct from the fan to the shaft 0.46 in. will be lost in shock. Using an outlet-velocity that is higher than necessary is uneconomical in the same manner that it is inefficient to compress air to 100 lb. per square inch and use it at 50 lb. per square inch. In the case of the fan we cannot help it.

This problem illustrates the term 'commercial efficiency' which I used some time ago. No. 3 fan, although mechanically not the most efficient fan for our purpose, is from a monetary or commercial view-point the best fan that we could select. In closing this series I desire to thank Prof. B. M. Woods, of the University of California, for his constructive criticism, and R. B. Guernsey, of the American Blower Co., for his interest and material aid in the preparation of these articles.

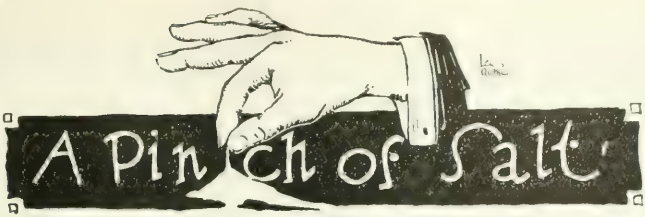
[This is the last of a series of articles by Professor Weeks on the ventilation of mines. The former articles appeared in the issues of April 24, June 12, June 19, and July 3.—Editor.]

Concentration of Magnetite Ore

The whole process of magnetic concentration as applied to the Eastern Mesabi magnetite ore is a good illustration of the manner in which the various machines can be made to work together so as to produce a high-grade furnace-product from an ore containing only 25% iron in the form of magnetite. The hard rock is first crushed to about 3-in. size and is then passed over a magnetic cobber. The field-strength of this cobber is so adjusted that all of the coarse material containing no magnetic iron is discarded as tailing. The concentrate from this cobber is still too low-grade to be useful, and is, therefore, crushed again to 2-in. size. This material is passed over a second cobber and the worthless gangue again discarded. This process of crushing, cobbing, and discarding worthless material continues until the product has been reduced to about $\frac{1}{4}$-in. size. When this stage has been reached, approximately one-half the ore has been discarded as tailing and the other half contains practically all of the magnetic oxide that was originally present in the rock. This $\frac{1}{4}$-in. material, however, still contains too much gangue to be a desirable furnace-product. It is, therefore, crushed wet in ball-mills until it will all pass a 100-mesh screen. This fine material is concentrated by magnetic log-washers in which the final separation is made. The concentrate produced by these machines is then de-watered by the use of continuous filters in the tank of which the fuel for sintering is mixed. The filter-cake is conveyed directly to the sintering plant, where the ore is agglomerated. After being sintered the ore is screened in order to remove any fine material, and only the clean coarse sinter is shipped to the furnaces. It is apparent that in order to make this process a success financially, a large initial investment is necessary. The plant must be built in the most substantial manner, and only that machinery can be used which will operate efficiently and continuously under heavy loads and with little personal attention. At best, the profit per ton that can be made is small, and in order to make the proposition attractive financially, a plant of large capacity is necessary. While this process is a success, from the metallurgical point of view, its financial worth must yet be demonstrated.

The Mesabi Iron Co., according to a recent bulletin of the University of Minnesota, is now undertaking the last stage in the experiment, that is, proving the financial worth of the process. A plant is being built on the eastern end of the Mesabi range, and it is hoped that within a year or two this plant will be in operation and will be contributing its share of ore to the yearly shipment from the district. It is extremely fortunate for the district and for the whole State that responsible individuals, who are willing to expend large sums of money in order to determine whether or not it is economically possible to produce a merchantable material from this low-grade ore, have become interested in this problem.

It is apparent that the success or failure of this first attempt means much in the history of the Lake Superior region. Thoughtful men of the iron-mining industry are watching the progress that the Mesabi Iron Co. is making with the greatest interest. They recognize the fact that failure means a gradual decline of the district, while success means the awakening of a new period of activity. If the hard rock of the Eastern Mesabi containing only 20 to 30% iron can be mined, crushed, and concentrated into merchantable product, it is not difficult to believe that the vast amount of comparatively soft hematite containing from 35 to 45% iron can first be rendered magnetic by roasting and then concentrated magnetically in the same manner as described above.



By Charles T. Hutchinson

Those who, from the title of this article, expect to find herein either a learned treatise on chemistry or a recipe for some new viand that defies the H. C. L. will be disappointed. The writer is neither a chemist nor a cook. There is salt and salt. There is the chloride of sodium of commerce, without which popcorn and many stories lack a necessary something to make them satisfying, and again, in mining parlance, there is that ingredient without which many mines would fail of promotion, and many samples would assay of Au nothing, and of Ag even less. Let us then hasten to plunge into the subject, now that the preliminaries are over, and we are settled in our easy chairs and prepared for the worst.

Some philosopher once remarked upon our debt to the great family of suckers, boobs, tenderfoots, and others of that ilk, who view with scorn the modest stock or bond that offers safety and a beggarly 7%, and who instead absorb like a sponge an unlimited quantity of gaudy stock certificates that have back of them nothing whatever but the alluring will-o'-the-wisp of something for nothing. These tender lambkins occasionally back a winner in spite of themselves, and the story of their rise to affluence through the 'investment' of a few paltry dollars furnishes bait for ensnaring new crops of easy marks for generations and generations. Without them, an occasional enterprise of real worth would languish and die; without them a lot of ingenious gents would have to go to work at honest labor.

In the great world of mines and mining, there are names to conjure with, names which have become securely established by lives of honest square dealing, that any enterprise with which they are connected is assured of financial backing from the very start. Mining men of this stamp do not hawk their wares along the highways and byways; theirs are not the ornate, mahogany, and brass equipped suites of offices with thick velvet carpets; they do not surround themselves with those sharp-eyed young salesmen whose eyes are generally too close together and who never look you straight in the face.

Many and devious are the ways of the fake mine-promoter. They would fill volumes if an attempt were made to describe them all, but, fundamentally the difference is nil; all are based upon certain elements of human psychology, greed, the gambling instinct, the desire that lies latent with all of us to get something for nothing, persisting in spite of all warnings of common-sense, and the touch of romance that with the human race begins at the cradle and stops only at the grave. Many men have made great fortunes by capitalizing their knowledge of these fundamentals, and many more have contributed their mites to the capacious maw of these predatory cormorants of finance.

Once upon a time, there was a promoter. He has now gone to his reward, whatever it may be, but for more than twenty years he flourished, waxing fat or lean, according to the times and the necessity for changing his base of operations after each fresh onslaught upon the treasure-chests of the tenderfoots. He was a survival from the Bret Harte epoch, externally and internally, except that he did not wear a beard. Physically he was not large, but stocky in build, with a deep chest and an iron jaw that bespoke tenacity of purpose.

He spoke two languages, Western United States and profane, the two being so thoroughly admixed as to cause one to think that the latter predominated, which, as a matter of fact, it did. Take the lurid diction of a mule-skinner's vocabulary, add the simple eloquence that would charm a bird off a tree, and you have an unbeatable combination when directed against either the wise men of the East or the unsophisticated denizens of the Middle-West.

Barnum said that the people like to be fooled, and especially do they like their doses of foolery coated with romance, flavored with glittering promises, and washed down with the hope of an affluence gained without exertion on their part. All of these things this mine-promoter furnished, again and again, with little if any variation in method, and with only an occasional change of base. California, Arizona, and Montana were the sites of his various Lost Peglegs, with an occasional incursion to Nevada by way of variety. His crops were harvested in the Middle-West, and even in Southern California, which the rich and idle Easterners make their playground, while the land of Harry Lauder furnished at least one batch of 'canny' Scots whose stock of 'siller' was reduceit mair than a wee drappie by a venture in Montana.

He was no wholesaler, this promoter. None of his stocks were hawked about either by salesmen or advertisements. He published neither house-organ nor market-letter. The New York curb knew him not, and the time-worn expedient of wash-sales as bait for the unwary was regarded by him as the trick of a petty larcenist. As a matter of fact, he was an artist in his chosen calling. He was the Caruso of the mining game, a Corot in his masterful command of colorful profanity, an alchemist

in his transmutation of basic quartz into shining coin of the realm.

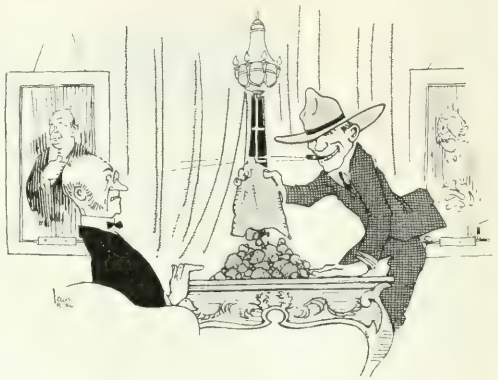
Always, he was within the law—just within. When the bubble was pricked, and the wails of anguish arose to high heaven from those whom he victimized, they found that they didn't have a leg to stand upon; there was nothing to do but write it off to experience account and shut up. Again he was so very select, as a general rule, in the choice of those whom he invited to "join him in a mining venture", that their very prominence worked against a bleat of any volume. Men of that stamp hate to admit that they have been done, and done brown, with plenty of gravy. Rather do they shut up, pocket their losses, and save their faces from the ridicule of their friends, and, what is even more important, save their reputations as shrewd men of affairs against the undoubted business injury that would react upon them from too much publicity.

How did he do it? Here is a story that is fairly typical. Up the principal street in the financial district of a certain city strode a man of the great outdoors. His tanned face showed exposure to the fierce desert sunshine. His gnarled hands bespoke familiarity with the single-jack and shovel. Over his shoulder was an ore-sack, bulging with specimens. His clothes were well cut without being at all dandified, and he wore them with a vigor and a grace that indicated a muscular body inured to physical activity. Reaching a well-known banking-house, he walked in without hesitation, stopped before the desk provided for depositors, wrote out a check and cashed it. It was during a slack period, and comparatively few people were about the room. Turning to one of the assistant cashiers, who called him by name, he growled, "I want to see the President; tell him I am here". Evidently he was a man who was at least sufficiently at home to command attention.

After a brief period of waiting, he was ushered into the holy of holies. Still clutching his sack of samples he greeted the great man, not in the least overawed by the outward and visible signs of opulence, the oriental rugs, mahogany tables and chairs, and oil paintings of former financial dignitaries that graced the walls.

"How are you, Mr. Promoter?" said the president, with the habitual air of reserve of the money lender, who hesitates to commit himself in advance, on even so trivial a matter as the state of the weather.

"How am I?" growled the promoter, "I'm fine as silk, of course, and why not? Last week we were running a cross-cut on the 100-ft. level of the Horned Toad shaft calculated to cut the vein that made such a won-der-ful showing in the surface croppings, the one I told you about last month. Well, just look at this." With that, he up-ended his sack on top of the president's shiny mahogany table, and a veritable cataract of samples poured forth. Quickly a pocket magnifying-glass was produced, which, carefully freed from dust by rubbing on the leg of the promoter's trousers, was brought into requisition. Silence prevailed for several minutes. One could see the bank president's eye glitter with cupidity. Here was money, even better, the real thing itself, gold, free gold, sticking out all over. The samples were literally riddled with it. Surely, that ore would go hundreds, perhaps thousands, per ton.



WITH THAT HE UP-ENDED HIS SACK

After a short interval, the bank president brought himself out of his beautiful dream, and his habitual caution struggled for recognition.

"Have you opened this up at all?" said he.

"Opened it up?" ejaculated the promoter. "Why I am in on this thirty feet already, and I haven't struck the foot-wall yet. It is a genuine fissure-vein, pitching about 10 degrees from the vertical, and, you know, a formation of that kind goes down all the way to China, and gets richer the farther down you go. Just as soon as I cut the foot-wall I am going to drift along the vein so as to prove it up, and then put in a raise so as to expose it on all four sides. I consider, from the showing so far, that the Great Horned Toad property is bigger and richer than the North Star or the Empire or any of those others which have been paying big for fifty years."

"Well", said the president, with a sigh, "I suppose you will have to go out and raise some money in order to develop and put in a mill."

"I don't know what I'll do", replied the promoter. "The P. D. & Q. people had one of their experts around the camp when the news of the great showing came out, and they want me to see them today, but I don't suppose they will give more than a half million for it as it stands, and I don't see why I should let them have a mine that will be worth five million or more within a year or so for any such figure as that. What I would prefer is to let some of my friends in on this and divide up with me, so we will all make money and tell that P. D. & Q. crowd to go to hell."

The fly was dangling, and the trout was about to rise. "How much will it take?" asked the banker.

"Well, now", replied the promoter, "I figure that I can enlarge and timber the working-shaft and sink it another hundred feet for about $8000. Then I must open up and develop about 50,000 tons of ore, which I can do easily with about 500 ft. of additional work under-

ground. Then, while that work is going on we can erect a 20-stamp mill and a cyanide plant, install about 100,000 gallons in water-storage capacity, build a bunk-house and other necessary camp-buildings. I have made careful estimates of the whole business, and," here the promoter paused impressively, "you know I never make a mistake; $200,000 will do the whole job."

Now spoke the banker, the shrewd man of affairs. "Entirely too much", he snapped. "You ought to get along with about half that. A 10-stamp mill is plenty big enough, and you can add to it from the earnings of the property. Then, why do you have to do so much work underground for the present? Why not get your mill up, and mine as you go along? Make the property pay its own way from the start."

"That's a good idea", replied the promoter. The fish was nibbling at the bait. "This ore is so rich that, even milling only forty or fifty tons a day we can net five or six hundred dollars right along, taking only the poorer rock and leaving the rich ore in place.

"Five or six hundred dollars a day", mused the banker. That was $15,000 per month, $180,000 per year. The investment was only $100,000. Truly, this was a toothsome morsel. Yet, doubt began to assail him. His habitual caution, struggling with the glittering promise dangled before his eyes, clamored for recognition. Then he spoke.

"I suppose you would have no objection to having an engineer go over the property and make an examination", he suggested, hopefully.

"Engineer", snorted the promoter, contemptuously. "Engineer, hell. Old maids in lace-boots, that went to college and write a lot of dam-fool initials after their names, think they can learn about mines from books, spend their time chewing the rag about pseudo-morphs while some goat is paying $100 a day and all expenses for their time. Then, after they are away a month they write a hundred-page report with ninety-nine pages about the weather, rainfall, and county politics, to say nothing about a lot of bunk on the geology of the district that nobody can make head or tail of, and then, in the last page they say 'Safety First' and turn it down, bill herewith for $3000, please remit."

"Well", replied the banker, "I'll think it over and see what I can do."

"I leave tonight for Boston", returned the promoter, shortly. "There is a friend of mine there whom I promised to give the first chance whenever I struck anything good. He wants to put up all the money himself, and I have no objection to him, personally, as he is a fine fellow. The only reason I spoke to you about it at all was that I have taken a great fancy to you and would like to put you in the way of making a lot of money for yourself. You could have taken the train back to the mine with me and looked everything over, taken your own samples and had them assayed anywhere you pleased. Then you could have joined me in this venture and looked after it yourself. Of course, you understand, I don't want any money for myself. You can put in your own book-keeper who will supervise all expenditures, and assure that every cent you put up actually goes into the mine and mill. We can organize a company and you and your friends can have 55% of the stock, which will give you control. I'll put in the mine for the remaining 45%, and you sign a contract agreeing to put up a mill and furnish the money for the additional development work. You don't take any risk at all on that basis. Well, I'm sorry to see you lose this chance." Picking up his samples and putting them back in the sack the promoter took his hat and started for the door.

The banker struggled. One hundred and eighty thousand a year; 55% of the stock. Perhaps he could freeze this innocent, rough, uneducated miner out, and get it all for himself. He gulped a second in indecision, and then, down went the bait, hook, sinker, and all.

"Hold on there a minute", said he. "I didn't say I wouldn't go into it."

"Well, I haven't got any time to waste fooling around here", replied the promoter shortly. "You meet me on the 6:10 train tonight. So long."

True enough, the banker met the 6:10 on schedule time. With him was a lawyer friend, well versed in the intricacies of legal chicanery. In due course of time, after leaving the main line, a 20-mile stage-ride brought them to their Golconda. It certainly was a picturesque camp. A few tents, with flies to fend off part of the fiercest rays of the midday sun, thatched on top with desert willow. In the centre a larger tent, similarly thatched, but open at the sides and end, served as what would now be known as a conference room. In the middle of the tent hung an *olla*, surrounded with moss, and filled with delicious cool water. In the corner were sundry cases of bottled goods, for snake-bites, probably.

BOTTLED GOODS FOR SNAKE BITES

Excavated into the hillside was a storehouse, filled with choice cuts of meat, poultry, and groceries. Every day 500 pounds of ice was packed in burlap, and carried by stage to the camp at a staggering cost.

Hot, tired, and dusty from their long ride, the visitors were conducted to their quarters, where a cool shower and a change of raiment—to say nothing of a real old-time Scotch highball, tinkling with ice, the glass frosted

with the dew—restored good temper, good nature, and a feeling of physical well-being that prepared the stage for the second act in the little comedy, for in those days, the 19th hole was still one up on the eighteenth amendment.

His victims being now regaled and pleasantly relaxed, the promoter brought out his specimens, and for two hours entertained them with tales of the desert, the mines he had opened, the money he had made for himself and friends. He was a wonderful talker, which, coupled with his picturesque profanity, caused kaleidoscopic visions of roseate hue to chase themselves across the imagination of his listeners. Already, they felt themselves fingering the glittering gold-pieces, or shuffling the sheaves of crisp banknotes, all won from Mother Earth.

After a dinner, or 'supper' as it is called, of unbelievable sumptuousness, excellently prepared by the competent cook at $150 per month, backed by an imported cigar and washed down with the Haig & Haig of our forefathers, the cold canny men of the money market took to their tents, and were lulled to sleep by the droning of the night-roaming insects.

That night, after all was quiet, our mine promoter took himself down the working-shaft, and then into the old drift and cross-cut. Candle in hand, he went over each inch of face with minute care. He did certain odd and curious things at regular intervals, taking something from his pocket, from a bulging ore-sack in his hand, and apparently planting—what? potatoes? No indeed, 'salt', just salt, in grains and lumps, not the chloride of sodium of commerce, but the good old specimen-rock, obtained from somewhere or other in anticipation of an occasion such as this. The work took several hours. It had to be done carefully and painstakingly, not too much, nor yet too little. It would never do to have the assay too high. That would immediately suggest mining and shipping to a smelter. The mill was what was wanted to play the trick, and $20, $30, or $40 per ton was about right. There are many ways of 'salting', from gold-dust propelled into the face of the orebody with a shot-gun to manipulation of the sample-sacks after they have been taken to the surface, but this particular artist in mineralogical camouflage preferred to plant it where it would do the most good, just like rows of potatoes. His work finally done to his own meticulous satisfaction, he, tired but satisfied, climbed the ladder to the surface, and, in turn, retired to his simple couch, there too, to indulge in his roseate dreams of the first stage in the shearing to take place on the morrow.

Early the next morning, the captains of industry from the busy city were awakened from their glittering dreams by the musical clang of a triangle fabricated out of an old piece of drill-steel and beaten by the efficient Chinese manager of the culinary department. "Bleakfass he leady. Hot cakee all catchum cole. Hully up quick fass."

Jumping into their clothes, a quick lick and a promise in the tin basin, and the banker and his lawyer friend made their way to the cook-house with an unwonted spring in their step, a resultant of the fresh early-morning air. Sitting on the rough benches, they did full justice to the grape-fruit, crisp bacon and eggs, followed by hot cakes and syrup prepared by the hands of a master. Oh, the psychology of the full stomach, and the

DO WE GO DOWN ON THAT THING?

innumerable men and women who, since the day of Esau, have sold their birthright for a mess of pottage!

Joined by the promoter, who had been up and about before them, their cigars lighted, they hied themselves to the collar of the shaft. There was the usual little headframe, a 15-hp. gasoline hoist, and a 750-lb. bucket. The two tenderfoots looked askance at the bucket, dangling just at the level of the opening, swaying a little and twisting back and forth. A slight shiver passed over them. Their cigars were suddenly bitter to their taste.

"Do we go down in that thing?" asked the banker, doubtfully.

"Of course you do", replied the promoter. "It is really very simple. Two of us go down at a time. Put your left foot on the edge of the bucket. Hold on to the rope with your hands, and fend off with your foot against the sides of the shaft as you go. I'll do the same on the other side of the bucket, and that balances the weight. Your lawyer friend will come down after us with Mike, the foreman. Come ahead now, let's get started, and you had better put these candles in your pocket."

With many inward misgivings, the banker grasped the oily rope with both hands, and, with one foot, stepped gingerly upon the edge of the bucket. The promoter duplicated this action on his side, and gave the signal to lower. Down they went, the bucket swaying and twisting, the banker trying to recall his boyhood prayers, now long fallen into disuse. After a seemingly interminable period, the bucket fetched up gently at the bottom, and they stepped off and lighted their candles to await the coming of the lawyer and the foreman. Again the bucket rose to the surface and returned, depositing its second cargo of human freight. "Come along", said the promoter, gruffly, "and I will show you the greatest ore deposit you ever saw."

Picking their way gingerly along the drift, they plodded on, the fitful glare of the candles shedding a ghostly light upon their white faces.

"Now, from here on", said the promoter, indicating the wall with his candle-stick, "you can take your samples. For 20 ft. this is all ore. It is all of good milling grade, with a rich seam running through it a few inches wide that will go hundreds of dollars to the ton. Now here", pointing to a series of irregular seams, "is that rich ore, and you don't want to bother with that because that is too high in value. Here are some sacks, and you can take your samples now, or I will take some myself and pan them for you right here before your eyes, so you can see the free gold yourself."

The banker and the lawyer exchanged glances. "We will take some samples and see you pan them now", replied the banker, "and then perhaps this afternoon or tomorrow morning before we have to catch the stage for town we can go underground ourselves and take some samples home for assay."

"That is perfectly satisfactory to me", said the promoter; "go ahead and knock down your samples."

Gingerly they turned toward the wall. Taking their candlesticks they made a few gentle dabs at the rock and succeeded in loosening a little piece which fell at their feet.

"Hell", snorted the promoter, "that's no way to take samples." He grasped his candlestick, and attacked the wall, apparently at random, with such vim, that in a minute or two, he had loosened enough fragments to make a sizable pile. He gathered it up in a sample-cloth, and carried it to a mortar, beside which was a pan, and a bucket of water. The tenderfoots looked on in rapt admiration. A vigorous pounding in the mortar soon pulverized the fragments. Scooping up a few handfuls he filled the pan, plunged it into the bucket of water, and then the really interesting part of the morning's entertainment began.

THE EXPERT MANIPULATOR PANS THE SAMPLE

With that delicate undulating motion, the expert manipulator began to pan the sample. As if by magic, the coarser particles of ore came to the top and were discarded. Little by little the contents of the pan were lessened, until finally nothing was left but a few tablespoonfuls of fine particles. With a quick twist of the wrist, the sample feathered. There were a few shining grains, that even in the half-light of the candles were different from the rest.

"Here you are", grunted the promoter, holding the pan up to their view.

The two tenderfoots craned their necks forward to see; their mouths open in wonderment. Before their eyes was a little string of particles, perhaps an inch long, shining, glittering gold, the real thing. A sigh went forth from both of them. They licked their chops in eager anticipation.

"How much gold is there?" asked the banker, the man of figures.

"About a dollar and a half", replied the promoter. "This ore is worth about $100 per ton. I will pan some more."

Quickly putting his thumb over the little thread of gold particles, he plunged the pan into the water with the apparent purpose of removing the result of his first panning before adding another batch, but the thumb over

the gold kept it in place, ready to 'sweeten' the result of the next test. His movements were so rapid that they were not noticed.

Another sample was panned. The resultant gold was nearly twice as much as the first. More oh's and ah's. Again the performance was repeated with the same result. Clearly, this was a marvelous mine. Evidently the promoter was too conservative in estimating its value. Quickly the thought chased itself across their minds. How could they get it all for themselves?

"I think we will get your foreman to help us to take some samples for assay now, while we are down below, so we won't have to come back tomorrow", suggested the lawyer.

"All right", acquiesced the promoter. "Mike, you help these gentlemen take all the samples they want. I will leave you now. Dinner will be ready in about an hour." With that he departed, leaving the embryo miners to their own devices.

With Mike on the job, they delved deep into the surface of the orebody, carefully preserving the samples in the little canvas bags provided by a thoughtful host for the purpose. Each bag was tagged and numbered, although why was not disclosed, as they had no map, nor even a sketch upon which to locate the points from which the samples were taken. However, such is life. The doctor who essays to take his own legal advice, the lawyer who believes in his heart that he is a great architect, and the banker who makes his own mine examinations, are no better than the stage Rube who thinks he knows under which of the three little shells the nimble pea is reposing.

After an hour of toil in the dank depths of the earth, the two tenderfoots, again wafted safely to the surface through the agency of the asthmatic coughing gasoline hoist, took their numerous sacks of samples to their tent for safe keeping until the time of their departure. They did not see the look of inquiry that passed from the promoter to the foreman, nor his solemn wink in return, indicating that all was well.

After brushing the evidence of toil from their clothes, the investors again met the promoter at the conference table, where cool drinks of a refreshing nature were copiously applied where they would do the most good. Soon the stage arrived, and the promoter sent them on their way rejoicing. Why didn't he rush it through before they got away? He was too good a general for that. Too great an eagerness to close before the assays of their 'own' samples had been assayed would have curdled the cream. The time for the hurrah was not yet.

A day, two days, three days elapsed, and then a wire came. "Meet me at my office in two days. Assays satisfactory", read the wire, that brought a grunt of satisfaction from the promoter. Forthwith, he slammed a change of clothing in his bag, caught the next stage for the railroad where he took train for the city, arriving in due course and taking up his quarters in the hotel. Immediately upon his arrival, he phoned the banker and made an appointment for the following morning.

Tomorrow arrived on time, as it sometimes happens, and promptly the promoter was ushered into the banker's office, and the office boy was instructed that an important conference was to be held and that he was to be incommunicado until further notice. The lawyer, of course, was on the job also, and there in a leather brief case was a mass of imposing-looking documents. Cigars were lighted, and the banker leaned back in his easy backed swivel-chair, fitting beautifully into his surroundings. Here, he was in his element.

"Well", began the banker, "we have had the assays made, and they seem quite favorable. The thing looks good", continued he, deliberately, "and Mr. Lawyer and I will go into the thing in accordance with the general terms you outlined, with certain modifications which I believe you will be wise to accept. Where are those contracts and incorporation papers?"

The promoter took the papers and skimmed over them with apparent carelessness. Stripped of legal verbiage, parties of assorted parts, if's, and's, and aforesaid's, they contracted to furnish the sum of $100,000, to be placed in their bank for the purchase of machinery and supplies, subject to draft signed by the promoter and countersigned by a secretary to be appointed by the banker. The banker was to O. K. the contract for the machinery and mill construction. A corporation was to be formed with a capital stock of $1,000,000, of which 45% was to be paid to the promoter in consideration of his deeding the mining property and all improvements thereon to the company. The other 55% was to be given to the banker, the lawyer, and two of their friends in return for advancing the $100,000 for equipment. This $100,000 was to constitute a loan to the company, and was to be repaid to the banker out of the first earnings of the company before any dividends were distributed to the stockholders. This was a pretty tight agreement, and the banker was quite pleased with himself in consequence. He waited for the promoter's verdict.

"Well", remarked the promoter, with a grin, "you certainly have this proposition sewed up in a sack. Now", he continued firmly, "there is one thing that I want thoroughly understood. I, and nobody else, am going to buy the mill and install it, and there is to be no interference from anybody. I don't care whether any of you fellows have a nephew, or a son-in-law, or a friend in the machinery business or not. I know exactly what is wanted, and it goes in as I say, or this deal is off right now."

The banker hesitated for a minute. "There is a man to whom the bank has advanced some money who has invented a new process for taking the gold out of rock by electricity, and I would like to give him a chance to put in this plant", he said slowly, "but if you are so set on having your own way, we will let it go. It is too bad, though", he continued regretfully, "for this is a very wonderful thing. There's nothing to it but some kind of a dynamo and some wire, and a magnet. You just crush the ore and then give it a little shock, and out comes the gold. I wish you would change your mind about it."

"You leave that shock business to me", replied the promoter, grimly, "I will take care of all the shocks that go on around that mine. This mill is going to have ten good honest stamps, with plates and a nice little cyanide plant. We will have a power-plant, a good pump, and a hoist with an automatic self-dumping skip, too. This plant is going to work, and work right, and any dam-fool inventor who wants to come around that property and shock my ore is going to take a long ride on the seat of his pants."

That was final. The papers were signed, sealed, and delivered. The funds were placed to the credit of the promoter, and he started for the machinery district to dicker for his plant. One week later he had contracted for his machinery, lumber, cement, and other building material, and, what was even more important, had had himself interviewed by both morning and evening papers. He was a picturesque character, and always good for a stickful of copy. The interviews were corkers. The mine was painted in glowing colors, as being simply rotten with wealth. The reporters played it up with all the language at their command, as they were assured in advance that there was no stock for sale to anybody at any price.

This done, the promoter hied himself back to the mine, and then began a period of feverish activity. Work began on the mill grade, the construction crew was organized. Up went a boarding-house, cook-house, and mine office, in which was installed an anemic-looking secretary selected for the post by the banker. Soon, the first carload of equipment was hauled in, and the new mill began to take form. Quietly, the promoter left for the nearest town and insinuated himself into the graces of the local correspondents for the city papers. He invited them out to the mine. Took them all around, filled them with good things to eat and drink, regaled them with tales of his own prowess, and showed them assay report after assay report of the workings of the Great Horned Toad Mining & Milling Company. When they departed, each with a nice pocket piece of specimen ore, richly sprinkled with free gold, they had material for several Sunday Supplement feature stories.

The promoter organized his publicity campaign with the skill of a master. Every week or ten days, he would drop into town, and feed boost talk to the correspondents. He had just come from the assay-office and would show them the results of the last 10 ft. in the south drift on the 100-ft. level, or he had just traced the outcrop of the vein for a thousand feet or so, and, just see what a wonder-ful showing it makes, and similar yarns with the same single purpose. Weekly letters to the banker were of the same import. He wafted them along on billowy clouds of imagery; he filled them with dreams of affluence; their nights were replete with beautiful dreams, their days with calculations of profits in six figures.

They talked. They always do. At the club, at the office, at their homes and those of their friends, at social gatherings, even at vestry meetings, there was nothing discussed but that Horned Toad mine, and its wealth. They were importuned on all sides by friends and acquaintances to be allowed to participate. When the promoter came to the city he was the cynosure of all eyes. He was dined, wined, and feted, and how he did bask in the limelight, and enjoy his brief period of adulation and flattery. Little by little the circle widened. The publicity, advertising, or whatever one may call it was insinuating its way through a constantly growing group of sheep, who were fast approaching shearing. The time was nearly ripe for the grand coup.

In a few months the mill approached completion. Then the day was set for the start, the launching of the enterprise that was to be marked by glittering bars of bullion.

MATERIAL FOR SEVERAL FEATURE STORIES

As the time grew nearer, the promoter was adding many names to a little list in a memorandum book that never left his possession. It consisted of men prominent in the business affairs of the city where lived the banker, and the lawyer, and made up the circle of acquaintances, in one way or another made familiar with the progress of the enterprise, and who had been under the influence of the subtle campaign of publicity launched by the promoter with the unwitting co-operation of his associates. One short week before the time set for starting the mill, a confederate of the promoter called upon him at the mine. There, in the dark of the night, they conferred long and earnestly. On the following day, without flourish of trumpets, the confederate left for the city where the banker and lawyer resided. In his pocket was a copy of the promoters list taken from the little private memorandum book. Also there was a bunch of neatly engraved stock certificates, in small denominations, not more than one or two hundred shares in each.

Upon his arrival at the city, he lost no time. One by one, the men whose names were on the list were approach-

ed. To each, the confederate told the same story. After swearing them to secrecy, he said that he was an old prospector, that he had assisted in locating the Great Horned Toad mine, that his share of the property was represented in so many shares of stock. Here, he exhibited a certificate that had been duly endorsed over to him by the promoter. He was hard up, broke in fact, and, although he understood that it had turned out to be a great property, he simply had to sell. Wonderful opportunity, a chance to slip one over on a man hard up, and who would have to accept most anything that was offered. He was shrewd however, this innocent hard-up prospector. He stuck out for a fair price, and, in almost no case did he take more than 10% less than par. So well did he do his work, so quietly did he go from man to man on the list, that he was cleaned up a day or two before the time set for the starting of the mill. Then a wire, a few cryptic words to the promoter, and a visit to another bank, the purchase of New York exchange for the entire amount, and it was considerable, and he caught a train for Broadway.

The day of the grand opening had come. The stage was set. The mill finished, the banquet table arranged for the banker, the lawyer, and their friends who were approaching the mine in special stages chartered for the purpose. The table fairly groaned with good things.

THE TABLE FAIRLY GROANED WITH GOOD THINGS

There were whole baked hams, cold turkeys, salads, relishes, superb hot biscuits prepared by the Chinese cook, a master of his profession. There at the side of the open tent, were tubs of bottled beer, surrounded by chunks of ice. In other tubs were pieces of cracked ice to add the necessary fillip to the famous Scotch, for which long glasses were provided. The table was set for forty, and as the first of the special stages rounded the turn, it appeared as if everybody had come.

There was the new mill, clean cut and beautiful to the eye. There the head-frame, there the new power plant, with the business-like smoke pouring from the stack. As the last stage came into view, the whistle blew, a loud discordant note proclaiming the advent of the conquering heroes, to whom the perils of the desert were as nothing.

Welcomed to the mine by the promoter, who was wreathed in smiles, they were conducted to the primitive wash-basins where they removed the stains of travel. Then the feast, that wonderful feast, that was like nothing else they had ever experienced. Filled to repletion, they lolled back on the benches, their cigars lighted, and listened to an impromptu address from the promoter. He told them lovely things about themselves, how great they all were, of the great debt that civilization owed to them, those pioneers of the waste places. He told them about the mine, as only he could, how rich it was, and how rich it would make them. Then he took them underground in batches and showed them around. He had put a round of shots in the roof of the drift making passage next to impossible. There they were, all dressed up, at times crawling on their hands and knees, and even tummies, candle in hand, down in the bowels of the earth, wishing they were safely topside once more.

This finished, they were conducted around the mill. They admired the imposing battery of stamps, they inspected the mysteries of crusher, automatic feeders, concentrating tables, the rows of tanks the purpose of which was to them a profound mystery. Then, at a given word, a rumble, then a creak, then a hum was heard. The darn thing was running. The breaker began its crunch, crunch, and the broken rock began to fall into the bin. Then the roar of stamps was added to the din, and soon, a watery mud began to trickle through the battery screens and run down over the plates. Then the concentrators began to shimmy, the filter revolved, in short everything was a grand success.

"I don't see any gold," anxiously remarked one of the guests. The promoter regarded him pityingly. "We always start up with waste until everything is running smoothly, and the adjustments are made," he replied. Satisfied, pleased at this exhibition of foresight, the guest retired. Taking the banker aside, the promoter said, "Tomorrow I will turn everything over to the superintendent you picked out, and who is due here in the morning. I am tired out with my hard work getting this mine started, and I am going to the seashore for a couple of weeks."

Surely, he was entitled to a rest, this hard worked miner. The banker acquiesced with a smile. He remembered his instructions to the new superintendent, "Run her for a week and then shut down for any reason you like. Then we will declare a series of assessments until we freeze that old duffer out."

The guests departed. The next morning the new superintendent arrived, and was met at the stage landing by the promoter, all packed, bag and baggage, ready to take the same stage out. "I am leaving everything for you with the book-keeper. You are in full charge and will report for instructions to Mr. Banker. I am going to the seashore for a rest. So long", and that was all. But, the promoter did not catch the train for the seashore. On the contrary he caught the Limited for the East, and, in course of time, at a well known New York hostelry, he met the hard-up prospector, now miraculously metamorphosed into considerable of a dandy, who greeted him warmly, almost affectionately.

The two retired to a room, where an interesting ceremony took place. It consisted of a division of sundry bright looking documents, New York drafts aggregating

a sum of money running into six figures. Let us leave them for the present, and return to the Great Horned Toad mine, and follow the new superintendent around.

This new superintendent was a competent man. He seemed to ignore the beautiful new mill, the mine office with its imposing sign, or the other surface indications of something, whatever it might be, at depth. He went immediately to his quarters, changed to his digging clothes, proceeded to the hoist house, and gave orders to be lowered. Candle in hand, accompanied by the foreman, he plodded through the short drift, crawled over the material which had been broken from the roof in preparation for stoping operations. Every few feet he stopped, looked, and listened for any explanation that the foreman might offer. None was forthcoming. Silently he continued on his way, and reaching the end of the drift, he turned, retraced his steps, and was hoisted to the surface. Immediately he gave orders to shut down the mill.

His lunch was eaten in silence. Then he sent for the foreman, and said, "We are going to sample this property immediately, as best we can. Get a couple of men with drills and get underground at once. I will show you where I want the shots put in."

For three days, the men were busy putting in the holes. Then they were fired, and the result carefully hoisted to the surface, crushed, quartered, and delivered to the assayer. A day or two later came the reports. Assay after assay revealed the cold, pitiless fact that of Au there was from a trace to 49c., and of Ag there was nothing that could be determined. In order that no stone might be left unturned, the superintendent then sampled the croppings, as far as he could trace them. The result was the same. There was nothing there, nothing but just plain ordinary country rock. The dose was not palatable. It lacked the pinch of salt.

Gathering up his documents, the superintendent caught the first train to the city. Upon his arrival he met the banker and the lawyer in the former's office, and there, quietly and in simple language, he told those two shrewd business men that they had been stung, that they had been bamboozled to the Queen's taste, that there had been nothing there, and that there was no indication that there ever would be anything there.

Shock, followed by consternation, then wild rage against the promoter who had dared to assault these hitherto impregnable treasure chests, oh! the language that rose to the high heavens, as they called him everything they could think of. They would have him arrested; they would send him to the penitentiary for life. Then the lawyer remembered that they had no grounds whatever for any action. He remembered that of all the crimes on the Penal Code, there was not one single one that they could pin on that wily promoter. They had been salted. Of that they were sure, otherwise how could those marvelous assays be accounted for, but of evidence, there was not one jot or tittle. They knew that the samples that had been assayed could not possibly have come from the 'Great' Horned Toad, but prove it they could not. There was no more. Of that they were sure.

Telephone calls from their circle of friends asking anxiously when the first clean-up would be made, first created suspicion, and then certainty, that the promoter had unloaded his stock at good prices through their own unwitting connivance. Little by little, as they began to recall the facts, all the circumstances reassembled themselves in their minds, and they realized to the full, their folly, and how cleverly they had been done. Analyzing the whole scheme for flaws in their own procedure, the banker, some months after, was heard to remark, "Well, I suppose it would have been better for me to have sent an engineer to examine the property before we got in so deep, but, anyway," this to himself, consolingly, "I saved two or three thousand dollars in engineers fees." His friend, who had been listening, asked with a smile, "And how much did you lose without the engineers' services?" The banker, startled out of his calm, answered "One hundred thousand". Then he saw the drift of the question. "Oh, go to hell," he snorted.

THE IRVINEBANK smelting works, in North Queensland, which were taken over by the Government last year for a period of 3½ months, up to December 31 produced 35 tons of tin valued at £11,770. The Government battery at Bainford treated during the year 1070 tons of tin ore, and 253 tons of ore containing wolfram, molybdenite, etc., and the recoveries were: black tin, 25 tons, valued at £3308; wolfram and bismuth, 44 tons, valued at £9783; bismuth, £112; or a total of 90¼ tons of concentrate, valued at £19,915. The plant is being further improved by adding to the storage capacity of the bins and by the addition of a magnetic separator for the purpose of separating bismuth and wolfram. The plant worked two shifts during the greater part of the year. The report of the Secretary for Mines states that the acquisition by the Government of the Chillagoe smelters, railway, etc., has led to a great revival of industry in that locality, as well as at Mungana and Einasleigh. About 75% of the ore supply for the smelters is expected to be derived from the last-mentioned mine. It is expected that the regular output of the works will be at the rate of about 200 tons per month. The complete return for March was: 153 tons of blister copper, containing 151.3 tons of pure copper, 7650 oz. silver, and 111 oz. gold; also 280 tons lead bullion, containing 272 tons lead, 16,880 oz. silver, and 39 oz. gold.

Electro-Metallurgy of Manganese Ore

Bulletin No. 5 of the Engineering Experiment Station of the University of Washington, 'Electro-Metallurgical and Electro-Chemical Industry in the State of Washington', by Charles Denham Grier, gives the following brief description of the process in use at the ferro-manganese plant of the Bilrowe Alloys Co. at Tacoma. In this plant, manganese ores from Philipsburg, Montana, are mixed with sufficient coke for reduction, limestone for fluxing, and a little metallic iron, and then smelted in six single-phase open-top shaft furnaces. Each furnace has a capacity of a little less than two tons per day when operating on the best ores. Four of these furnaces are enclosed in shells of $\frac{3}{16}$-in. boiler-plate, 77 in. diam., 69 in. high, flanged at the top, with a 6-in. strip of brass running from top to bottom to break the magnetic circuit. The shells are cooled by a water spray from a perforated pipe that encircles the shell near the top. The other two furnaces are of reinforced concrete, $7\frac{1}{2}$ ft. square on the outside with a circular central shaft 79 in. diam. The lining of both kinds of furnaces is the same. At the bottom is a water-cooled cast-iron grid, which is embedded in and under the rammed mixture of ground carbon, graphite, and coal-tar that forms the bottom of the crucible. The side-walls of the crucible are made of California magnesite and extend up above the smelting-zone. Above this, the lining is of hard-burned firebrick, which will best withstand the abrasive action of the charge and of the poking necessary to ensure proper descent of the charge.

The two concrete furnaces each have a guide, which extends from the sides and across the top of the furnace to hold the electrode in the centre of the shaft. The other furnaces lack this feature, and their electrodes are merely supported by steel cables from a car-truck overhead. In all except one furnace, 16-in. square, amorphous carbon electrodes are used; in that one 20-in. round electrodes of the same material are used. The electrodes have threaded recesses in each end and new lengths are joined to the electrode in place by means of a threaded plug screwing into both pieces. A paste of graphite and raw linseed oil is used between the surfaces to increase the conductivity of the joint. Putting on a new length requires from ten to fifteen minutes with the concrete furnaces, but from one to two hours on the other furnaces.

The electrode-holders are in two parts, which clamp on the sides of the electrodes. They are water-cooled. The flexible water-connection required is an asbestos $\frac{1}{2}$-in. steam-hose. These holders have arms that extend past the side of the furnace where the clamps which make connections with the leads are bolted on. A counterweight balances this eccentric weight. Some trouble has been experienced with the holders, as the electrode faces are irregular and good contacts are not made over the entire surface. This results in hot spots, which eat away the carbon, sometimes producing an arc that attacks the copper, and frequently allows the suspended electrode to drop into the bath.

The power required for each furnace is approximately 350 kilowatts. The current is supplied to the terminals of the furnace at about 55 volts. The power factor is said to be about 90%. The conductors to the furnace, which are $\frac{1}{4}$ by 6-in. bars, are placed close to each other to minimize reactions, and the magnetic circuit in the shell is opened by the strip of brass mentioned before. The energy required per long ton of product is said to vary between 4600 kilowatt-hours, which is the amount used when running on the best ores, to an average of 5500 kilowatt-hours, which was the figure obtained over a period of four months while using the different grades of ore shown below. Power is purchased at rates varying with the load factor, and this is usually such as to earn a rate of from 3.31 to 3.52 mills per kilowatt-hour. Under the power contract, the plant is subject to shut-down in case of low water. During the past two years it has lost approximately ten days together with three or four minor interruptions.

The following analyses represent the different grades of Montana ore used:

	Mn	SiO_2	P	Fe	Al_2O_3	Moisture
	%	%	%	%	%	%
Concentrate	49.13	9.4	0.081	1.0	2.7	10.3
Washed ore	42.07	20.2	0.092	1.3	4.0	12.2
Coarse good ore	47.08	15.08	0.055	1.2	3.0	5.81
Coarse poor ore	38.27	23.4	0.077	..	6.0	9.55

The concentrate is fine and tends to pack in the furnace so tightly that the gases formed by the furnace reactions cannot pass freely. The result is that gas accumulates until the pressure is high enough to force a passage, which is usually along the electrodes, through which it 'blows' with considerable force, materially shortening the life of the electrode. To minimize this trouble, coarse ore is mixed with the concentrate in equal quantities. It is also found necessary to mix the ores so that the Al_2O_3 content does not exceed 4%. Ores exceeding this amount yield a slag which does not separate well from the metal, which is entangled in, and clings to, the slag when cool.

Typical analyses of the ferro-manganese and the slag produced are as follows:

Ferro-Manganese	%	Slag	%
Manganese	80.03	Manganese	13.97
Iron	11.5	Ferrous oxide	1.2
Silicon	0.6	Silica	34.7
Phosphorus	0.274	Lime	35.8
		Alumina	4.6

The ingredients of the charge are bedded in small bins and are mixed by shoveling into the charge-cars which carry it to the furnace. The furnaces are fed continuously and are kept poked down at all times except during the 20 minutes before tapping. It is desirable to have the furnace crust over before tapping so that no imperfectly separated material will be tapped out. The ferro-manganese and slag are tapped into shallow cars every two hours, allowed to cool for several hours, after which slag and metal separate along a clean line if the charge has been correctly proportioned and the alloy is ready for shipment.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

DRILLING CONTESTS AT JEROME.

GLOBE.—The Old Dominion company has developed high-grade ore on the Maggie vein, north of the 'A' shaft on the 19th level. Assays running from 10 to 34% have been reported. The company is now cutting a station on the 20th level, which will automatically drain the 19th and permit active development on the Maggie vein at that level. Production for the month of June was considerably in excess of that for the month of May, which amounted to 2,287,000 lb. of copper.

It is reported that the Arizona Commercial has opened rich ore in its raise that is up a distance of 85 ft. from the 1600-ft. level. This is now within 15 ft. of the 1500-ft. level and practically assures the company 100 ft. of ore yielding in the neighborhood of 10% copper. On the 4th level, where commercial ore was recently found, drifting continues with the orebody which shows no diminution in size or quality. The company is producing 600,000 lb. of copper monthly at a cost of approximately 14c. per pound.

During April, according to monthly bulletin sent to stockholders by Frank P. Knight, president, the production of the Iron Cap Copper Co. amounted to 654,125 lb. of copper and 8807 oz. of silver. The mill is operating satisfactorily and production is estimated at about 300 tons per day. It is said that on June 9 the Supreme Court of Maine handed down decisions in the suits brought by the Arizona Commercial company. In the apex-case the bill was sustained. Counsel for the Iron Cap has asked for a re-hearing.

BISBEE.—The ventilating shaft which is being put down in the neighborhood of the Briggs mine of the Calumet & Arizona Mining Co., has reached a depth of 300 ft. An average of more than eight feet per day has been attained since the work began, and during last week 54 ft. was sunk in six days. When completed the shaft will be more than 800 ft. deep. The company is installing two more boilers which will give the boiler-plant a total of 15. The increased capacity is for use in handling the increased flow of water that is expected to develop as the Junction shaft is deepened. Plans for sinking the Junction shaft from the 1800 to the 2200-ft. level are now under way.

SUPERIOR.—Announcement has been made that John Fowle, vice-president and general manager of the Silver King of Arizona Mining Co., has been appointed receiver of the company by the Superior Court. It appears the Silver King company is having difficulty in financing property and Mr. Fowle will keep the water pumped out of the mine and look after the property generally.

JEROME.—Unusual interest was aroused by the drilling contests held in the town of Jerome during the two holidays on July 4 and 5. Contests in both hand and machine-drilling were held. Seven teams of two men each, entered for the machine-drilling contest, two from the United Verde, two from the United Verde Extension, and one from the Jerome Verde. A large block of granite was brought over from the famous granite mountains of Prescott, expressly for the purpose. The betting was fast and furious and several thousand dollars changed hands before the United Verde teams were declared the winners of both first and second money. The first prize, which amounted to $250, was won by Navarette and Navo, of the United Verde. The winners showed them all a trick by making but three changes of steel in drilling the last hole instead of four changes as made by the other competitors. Each team was required to drill two holes, one above, and one below the bar, and the program for each team was to set up the standard, attach the bar, connect air and water-hose, drill a 5-ft. hole, turn the drill under the bar, and drill another hole.

The time taken by each team is as follows:

Team	Set up	1st hole	Change	2nd hole	Total
Gerkovich and Mulich	2:32	6:06	1:11	4:59	14:48
Gomez and Lopez	2:16	7:06	1:38	6:21½	17:21½
Vincente and Mendiaz	2:05	7:59	1:20	7:19	18:43
Lopez and Fernandez	1:47	7:21	0:50	6:34	16:32
Navarette and Navo	2:03	6:28	0:56	4:54½	14:21¼

The quickest set-up was made in 1 min. 47 sec., while the longest took only 2 min. 32 sec. Ordinarily it takes a man from 20 to 40 min. underground to set up and prepare to drill his first hole.

Four teams entered for the double-jack hand-drilling contest: Townsend and Slade from the United Verde, Lopez and Gomez from the Jerome-Verde, McKinnon and McKinnon from the Grand Island, and Schull and Wolf from Turkey. Thousands of dollars were wagered on the contest. The results were as follows:

McKinnon brothers	31⅝ inches
Schull and Wolf	29 "
Lopez and Gomez	27¾ "

Immediately at the conclusion of the contest Schull and Wolf challenged the winners to another competition for a purse of $500 and the McKinnons not only accepted the challenge but suggested that they still had another $500 and would like to wager it as well. The local record is 35⅝ in. and the State record is 39¾ in., made 12 years ago in Bisbee.

CALIFORNIA

SEVERAL MINES IN NEVADA COUNTY SUSPEND OPERATIONS.

AMADOR COUNTY.—The water level is being lowered slowly at the Argonaut mine. The pumps are now working smoothly. Tanks are also used in hoisting water. No move has yet been made by the Kennedy company to operate its plant although the hoist has been completely overhauled and placed in readiness to commence at any moment. From what the public can learn it is believed that a move will be made shortly by the Kennedy people to bear their part of the expense in draining the underground workings. At this writing the water has been lowered about 65 ft. below the 3100-ft. level.

In cutting a station at the bottom of the recently sunk section of the shaft at the Plymouth Consolidated mines, a body of high-grade ore, assaying $70 per ton, was uncovered. Just what the length and width of the new find is, cannot be known until further development is done, but 16 ft. of ore has already been cross-cut. The find is important and comes at an opportune time. The ore hoisted from drifting in the 600-ft. winze in the Bunker Hill mine, from which so much was anticipated, is so low-grade that it goes over the dump. Prospecting still continues. The Keystone at Amador City is doing nothing beyond keeping the mine drained.

NEVADA COUNTY.—The controversy which has existed for a number of months between the North Star and Empire Mining companies and other users of water and the Pacific Gas & Electric Co. was recently decided by the Railroad Commission in favor of the water-users. The latter company sought to compel the water-users to change to electricity necessitating the expenditure of many thousands of dollars. After years of operation the North Star Mines Co. has decided to abandon the Champion mine on Deer creek, a mile below Nevada City. The property consists of a large area, the greater portion of which has been acquired as the result of litigation with the Home Mining Co. and other properties, due to alleged charges of trespass, and on account of a complex vein system. The mine operated two shafts and was equipped with a 40-stamp mill and a cyanide annex. Formerly the mine was a producer but of late years small bodies of ore encouraged continued prospecting until within the last year. High costs and lack of ore-reserves have compelled the company to close permanently. Nevada City is thus left without a single quartz mine within its immediate vicinity. A force of men is already at work dismantling the machinery and buildings.

R. H. Long of San Francisco stated that the old Excelsior mine at Meadow lake will be re-opened shortly, treating the ores by the cyanide process. The Golden Gate mine, idle for some time, has been abandoned. It adjoins the Idaho-Maryland property. Operations at the Lily have come to a temporary standstill pending a better understanding among the stockholders. George Mainhart of Nevada, Harvey I. Miller of Salt Lake City, George Packard and J. S. Oiler of Boston, have recently been looking over the Mother Lode section and the Grass Valley district.

PLACER COUNTY.—The Rising Sun mine at Colfax has commenced mining in earnest, the 10-stamp mill treating ore of ordinary grade. The ore is automatically handled from skip to mill.

COLORADO

'DOLLAR' SILVER IS REVIVING COLORADO DISTRICTS.

CRIPPLE CREEK.—Old mines and old miners are making good: as a result of recent work two rich gold discoveries have recently been made. The first was at the Strong mine, Battle mountain, near the surface, and the second, at a depth of 750 ft., on the American Eagles property, located personally by the late W. S. Stratton. An 'old timer', George Furst, has opened up a rich vein, on the upper Strong fraction, immediately adjacent and cutting into a later location the Queen of the Hills, of the Portland company. Samples taken across 2½ ft. of vein matter, have returned $75 to $800 per ton. Furst has taken out about 45 tons and his first shipment will be loaded next week. He will install an electric hoist if returns are as good as the assays.

The second discovery has been made by F. M. Kurie, former superintendent of the Portland company, who has been mining and shipping a good grade of milling ore from two blocks of the Stratton estate, Bull hill, operated through the Star of Bethlehem shaft. He recently secured a modification of his lease whereby the depth was extended and he was permitted to operate from the American Eagles deep shaft. By a short cross-cut Kurie has opened up, if not the vein he was seeking, one with better prospects as two drifts now being run on the vein have both breasts in ore and samples show four ounces gold per ton.

A vein of altered granite, not hitherto cut on the property, has been found in sinking the Empire State shaft of the Isabella Mines Co., below the 900-ft. level station. The vein has two streaks, two feet apart, that sample $30 to $50 per ton. It has a north-west strike and dips strongly to the north-west. The shaft is to be continued to the 1500-ft. point. Development work at the Last Dollar shaft, Modoc Consolidated Mines Co., is centred in the long cross-cut through the Combination claim, to the north-west. This cross-cut when completed will be 2400 ft. in length, with cross-cuts at intervals to exploit this undeveloped territory. The cross-cut should cut every known vein and dike that traverses this claim. At the 1200-ft. level, three veins are under development in ground south and east of the shaft.

GILPIN COUNTY.—A rich strike has been made on Idaho hill, on property adjoining the old Mackey mine, by the Elk Park Mining Co., a Denver corporation. At a depth of 200 ft. the Annie H. vein, first opened in an upper shaft on the property, has been cut and samples assay two ounces gold, 16% copper, and two to five ounces silver per ton. In addition there is 2½ ft. of mill-ore assaying $11 to $13 per ton. The company has a stamp-mill on the property but plans to install a flotation unit to handle the sulphide ore.

GEORGETOWN.—A recently organized Wisconsin com-

pany, the Brown Deer Mining Co., is starting work on the Reindeer lode near Silver Plume under management of Thomas Buxton. Operations have been resumed in the Cutley tunnel near Berthoud pass and on the property of the Republican Mines Co. Contractors have started an extension of the Clinton tunnel.

Central City.—Smelting-grade ore has been opened up on the Annie H. mine at Apex, above Black Hawk. The streak measures eight inches, in addition to some mill-ore. Operations have been resumed on the Evergreen property, and the milling-plant is shortly to resume treatment. The Rochester tunnel of the Saco de Oro company has been re-timbered and work resumed in the breast, where streaks of galena have made their appearance. The tunnel is heading for the discovery shaft, where rich silver-lead ore formerly was mined. Silver-bearing ore has been opened up in the Yankee Hill district by owners of the Saunders-Gobelman property. The Chase mine is to be unwatered and the shaft sunk 100 ft. from its present depth of 450 ft. The Rara Avis, a silver-lead producer, one of the richest mines of the earlier days, has been leased to Kansas parties. The property has been in litigation some 30 years and has been closed for this time. The shaft is 550 ft. deep but in unworkable condition and a tunnel already in 600 ft. will be extended to cut the shaft at the 300-ft. point. The property according to the records has produced ore running as high as 1300 oz. silver per ton, and ore is reported by 'old timers' to be still exposed in the lower workings.

Lake City.—A contract for 1000 ft. of work in the Hidden Treasure tunnel has been awarded to local miners and work has commenced. An aerial tram is to be constructed from the Cleveland tunnel to an ore-house under construction on the county road, thereby reducing the haulage to the shipping point on the D. & R. G. railroad. The lessee on the Fannie Fern on Benson creek is shipping silver-lead ore of high value to the smelter. The Mountain Chief group near the Fannie Fern is being operated by the Standard Mines Development Co., a common-law trust recently organized by G. R. Harkness, prominent mining man of Hinsdale county, and Denver men. Ore is exposed in tunnel-workings that assays as high as 472 oz. silver and 1.63 oz. gold from the foot-wall streak, with fully six feet of milling ore in addition. In the shaft workings, ore assaying as high as 640 oz. has been mined, and a tunnel is now projected to cut the vein at depth. Dollar silver is proving an incentive to silver mining and a number of Hinsdale county properties have recently been examined.

Silverton.—The Early Bird property owned by C. B. Mitzkie of Silverton and operated under bond and lease is producing high-grade gold-silver ore. A recent shipment of sacked ore, of small size, netted the operators $1470. A second shipment of rich ore will be made soon. The Bagley mill has been bought under writ of execution by C. B. Blitzkie and will be overhauled and put in condition to treat custom ore. The Gnome Mining Co. has increased the working force at its properties at Animas Forks, where development is in progress.

MICHIGAN

OUTLOOK FOR THE COPPER PRODUCERS NOT IMPROVING.

The coal situation continues to be the most important problem for every copper mine in Michigan. The problem is in no wise helped by knowledge of the fact that there is no hope for any reduction in prices, and there is doubt whether coal in sufficient amount can be secured even at the present going prices. To add to the prevailing pessimism there is the continued shortage of labor and the fact that there is little evidence in present shipments of an increased demand for the product of the mines.

Wolverine is going to show an improvement in the content of its rock this month, and what is now going to the Wolverine mill contains 20 lb. per ton. Wolverine No. 4

MASS COPPER IN THE QUINCY MINE, MICHIGAN

shaft is shut-down temporarily. The tonnage is increasing from No. 3. The Wolverine stamp-mill is idle for a few weeks to make repairs to the rock-bins, and the Wolverine ore is being cared for at the Mohawk mill. The tonnage now is coming from the 38th level and the four levels above, including the foot-wall, arches, and pillars. Wolverine now is holed-through to the North Kearsarge so that it is not necessary to handle the extra water which has been coming from the South Kearsarge.

Seneca's shaft now is approaching the 5th level. The 3rd and 4th level drifts are being pushed to the property limits, with the thought of securing greater lateral distance before further stoping. This policy makes it necessary, temporarily, to forego the increase in tonnage anticipated. Under existing conditions of the market this is not objectionable. Development work in the Gratiot shaft is exposing much barrel and small mass material. Mohawk is securing considerable silver from points below the 16th level. It does not appear in nuggets, the particles being quite fine, recoverable only in the smelter.

MONTANA

LUMP GULCH MINES ARE SHIPPING TO THE PLANT OF THE NEW YORK-MONTANA TESTING & ENGINEERING CO.

Marysville.—A new 5-ft. fissure has been opened on the 400-ft. level of the Shannon mine of the Barnes-

King Development Co. The ore assays $14 per ton in gold.

HELENA.—Another high-grade ore-shoot has been opened at the Vera Cruz mine in the Lump Gulch district after drifting west and cross-cutting to the south from the 4-ft. orebody recenty reported. The new ore-find strikes with the first discovery and shows similar assay values, namely, 5% copper, 78 oz. silver, 1 oz. gold, 18% lead. M. J. McEvans is superintendent. Ores from both the Liverpool and Monarch mines are now being treated at the plant of the New York-Montana Testing & Engineering Co. Plans have already been completed for increasing the output of this plant.

NEIHART.—Practically normal conditions are prevailing in most of the mines in this district. The Hartley mine is employing 18 men. Ore is being taken out from two stopes on the 300-ft. level. At the Silver Belt and Blackbird mines, similar conditions exist. Twenty-two men are employed. Development work is being completed to connect the two mines and thus reduce haulage-costs. On the 200-ft. level of the Silver Belt, a 4-ft. vein has been uncovered. The ore is said to run 50 oz. silver per ton and 35% in lead. After a second walk-out at the Flohart mines, the men have returned and promise to remain regardless of any further action by the labor union. The wages and conditions are satisfactory.

NEVADA

ADDITIONAL TIME GIVEN IN SALE OF SILVER HILLS MINE.

TULE CANYON.—Three stamps that crush 10 tons each daily have been added to the five light stamps in the old mill at the Silver Hills, giving a total capacity of 40 tons. Ore is being stoped from above the 50 and 100-ft. levels and the mill-heads are maintained at 40 oz. silver. The concentrate assays 1000 oz. The west drift on the 50-ft. level is 85 ft. long and the east drift is 75 ft. long. The west drift on the 100-ft. level is 65 ft. long and the east drift is 90 ft. long. There is an 8-ft. width of 106-oz. ore on this level. The shaft, which is being sunk from the 100-ft. level, has passed out of the vein and a cross-cut will be driven at 200 ft. The condition of the vein at 200 ft. will decide definitely whether the sale will be concluded and Ingalls and Mercer, the owners, are so confident ore will be found that they have extended the time for the second payment from August to December. Neither ore nor concentrate has been shipped since the Silver Hills started work. There has been found on the 50-ft. level a piece of almost pure silver five inches in diameter. This was sent to the New York office of the company. The inclined shaft now being sunk is single-compartment, but if ore is found at 200 ft. a double-compartment vertical shaft will be sunk and electric power will be secured from the line of the Nevada-California Power Co. at Palmetto. Thirty-five men are employed.

WEST DIVIDE.—Work has been resumed in the West Divide after a shut-down of two weeks caused by lack of funds. L. L. Patrick, promoter and manager, says he has been assured by Zeb Kendall, already heavily interested, that he will furnish additional money sufficient to prospect the vein at a depth of 150 ft. An inclined shaft was sunk 65 ft. in the vein and drifts were driven with good results. An old tunnel was then extended and a vein was cut south of the shaft at a depth of 150 ft. This vein was supposed to be the same as that in the shaft and a drift was driven toward the shaft without opening ore. When the drift reached a point under the shaft a resurvey showed the possibility that the work had been done in a parallel vein and a cross-cut was started to find if this were true. This cross-cut is now 65 ft. long. It will be advanced 10 ft. more and if another vein is not found a raise will be driven from it.

DIVIDE.—Work has been stopped at the Alto and East Divide because of lack of funds, according to J. K. Turner, consulting engineer for both companies. There is 300,000 shares of stock in the Alto treasury, but to continue work it would have been necessary to sell this at one cent or less per share. "We can't interest anyone now and intend to let the affairs of the company rest," Mr. Turner said. The Eastern stockholders in the East Divide are reported to have a plan to re-finance the company without levying an assessment. Sinking of the Sutherland shaft has been stopped at 900 ft. and lateral work has been started at this depth. At a meeting of stockholders in the Belcher it was voted to reorganize the company on an assessable basis. The shaft of the Gold Zone, being sunk from the 500-ft. level, is nearing 800 ft., where an attempt will be made to find the extension of the Tonopah Divide ore-shoots, which, according to engineers, will be found in the Zone at this depth. The Kernick, a short distance west of the Tonopah Divide, is planning to sink to 1000 ft. from the present depth of 500. It is said that before the present management took charge the main south-east drift on the fifth level of the Tonopah Divide was in error turned from the main vein and driven outside the vein to the Gold Zone boundary line. This is the most recent development in the efforts of George H. Garrey and William Watters to determine what became of most of the $9,000,000 worth of ore that A. I. D'Arcy estimated was in the mine in July of last year. Reports say the main vein has been found in a cross-cut from the drift and engineers take this as an indication that perhaps the future of the mine is not as black as it has been painted in recent months. A drift on the third level has been driven 50 ft. in a vein parallel to the main one, the ore for the width of the drift assaying more than $35 for this distance. This vein has not been cross-cut.

RAILROAD SPRINGS.—The 70 ft. shaft of the Silver Coin has been cleaned, a hoist and head frame are in place, and it is planned to sink the shaft to 100 ft. before drifts are driven. J. K. Turner, consulting engineer to the company, estimates that there is four carloads of $60 ore available for shipment through Goldfield, 23 miles north. The Silver Coin is being developed under lease by the Crescent Divide, which has $4000 to $5000 in the treasury.

GOLDFIELD.—Work from the 815 ft. level of the Grand-

ma has been stopped and sinking of the shaft has been resumed. The Great Bend, after driving around caving ground on the 375-ft. level, is cleaning the raise from this level and when this has been completed drifting from the raise will be resumed. Ore 6 to 9 in. wide and assaying $315 for a distance of 12 ft. has been found by a lessee on the 60-ft. level of the old Patrick-lease shaft of the Lone Star. No work was done south of the shaft by the early-day lessees and the ore was found by drifting 8 ft. in this direction. Work has been stopped on the 60-ft. level, with the face of the drift in rich ore, and a drift is being driven at 80 ft. The company has started work at 220 and 250 ft. to search for the same shoot. When this ore is shipped it will be the first to come from the Lone Star

SURFACE PLANT AT THE VICTOR SHAFT, TONOPAH EXTENSION MINING CO.

in many years. The find was made by George Meuli, a pocket hunter from the Mother Lode country in California, after many efforts had been made by others to open ore in the same workings. The Spearhead has erected an electric hoist at the 112-ft. winze from the 910-ft. level and sinking has been resumed on a 5-ft. vein of quartz in the alaskite.

UTAH

SUIT FOR ACCOUNTING IS FILED AGAINST DIRECTORS OF THE MONTANA BINGHAM COMPANY.

SALT LAKE CITY.—Inquiry of the Federal Trade Commission into charges that the Minerals Separation Corporation, Minerals Separation North American Corporation, Beer-Sondheimer & Company, and other respondents, by an oppressive system of license agreements with mining companies for the use of flotation processes, have supressed competition, opened at the Federal building in this city on July 13. Representing the Commission were Huston Thompson, chairman; Claude R. Porter, chief counsel, and Gaylord R. Hawkins, assistant counsel. Among the mining men who were called to testify were Frank J. Westcott, secretary of the Silver King Coalition Mines Co.; Geo. T. Hansen, of the Midvale Minerals Co.; Geo. W. Lambourne, president and general manager of the Judge Mining & Smelting Co.; O. J. Salisbury, president of the Ramshorn Mining Co. of Idaho; L. D. Anderson, of the United States Smelting, Refining & Mining Co.; and Anthony H. Godbe, president of the Prince Consolidated M. & S. Co. of Pioche, Nevada. The following day, Thomas Varley, superintendent of the local station of the Bureau of Mines, was the principal witness. Mr. Varley's testimony was that he considered the license rate of the Minerals Separation Corporation and the other respondents had greatly curtailed the production of ore and its treatment by the flotation process, as the royalty charges were so excessive that many of the smaller companies and individuals could not afford to pay them. On the evening of July 14, Geo. L. Nye and Gilbert H. Montague, attorneys for the American Mining Congress, met at the Alta Club with a number of local mining men, explaining why the Congress was aiding the Trade Commission in its inquiry into the license methods of the Minerals Separation Company and its associates.

BINGHAM.—All preliminary preparations have been made for resumption of work at the old New England mine, now owned by the Utah-Boston Development Co. It is stated that the main working-shaft will be extended from the 300 to the 800-ft. level.

The Utah Apex Mining Co. is now employing 285 men at its mine and mill. V. S. Rood, general manager, re-

ports that the company is getting good results from the contract work in some of the large orebodies. In this work, the men are paid for the work they accomplish; the company furnishing all necessary materials, power, and powder.

It is reported that the main workings of the Montana Bingham property are to be connected with the Mascot tunnel of the Ohio Copper Co., for the purpose of facilitating transportation. Recent shipments from the Montana Bingham have ranged from 6 to 16% copper, 2 to 6 oz. silver, and $1.50 to $4 in gold per ton. Suit for an accounting of the affairs of this company was filed on July 14 by several of the stockholders against the directors and others. The complaint charges that the company's funds have been and are now being squandered in excessive salaries and bonuses; that the directors of the company secured control for the purpose of handling the funds for their own benefit. The complaint further charges that the defendants agreed to purchase 500,000 shares of the treasury stock of the company at a stipulated price of 50c. per share, on which consideration they were elected to the directorate. It is stated that not more than 265,000 shares of the stock has been so purchased. It is also alleged that C. G. Ballentyne was elected president and general manager for the company at a salary of $105,000 for five years and that he was given a bonus of $10,000 to come here from Honolulu to take charge of the property.

Tooele County.—Ore-hauling has been resumed from the old Sharp mine, located about ten miles from Benmore, and about twenty miles from the Salt Lake Route. This mine was a heavy shipper some years ago, but in recent years only a small amount of ore has been mined. During the past winter operations were conducted in a limited way, and the ore extracted was piled until such time as the roads would permit of hauling it to the railway. The ore is rich in lead and silver. In the same section of the county, Alex Caldwell is developing a number of claims, in which there is reported to be a good showing. No ore has as yet been shipped but it is hoped to commence stoping later.

Eureka.—John Manson, manager of the North Standard property, has been spending considerable time here of late. The shaft is below the 600-ft. level and sinking will be continued until the 1000-ft. level is reached if the showing warrants. A meeting of the stockholders of this company has been called for August 2, at which time a financial report, covering operations of the company to date, will be submitted. Recently there has been considerable opposition to the present management, and a lively time is expected at the meeting.

The Eureka pumping plant of the Grand Central Mining Co. was recently dismantled and the equipment moved to Mammoth, where it will be re-erected. Instead of getting its water from the wells at Eureka, the Grand Central is now being supplied by water from the springs near Diamond; this latter supply, running by gravity to Mammoth, is then pumped to the mine, the lift being considerably less than required at the Eureka wells. The Grand Central is mining on all levels between the 540 and the 2100 at present.

Park City.—During the week ending July 10, the Keystone Mining Company made its initial shipment. The Ontario Silver company is also shipping again, following a shut-down due to compressor trouble. The total shipments from the camp for the week were 2065 tons, as against 1807 tons for the previous week. The Ontario shipped 663 tons; the Silver King Coalition, 413 tons; the Judge M. & S., 534 tons; the Daly-West, 235 tons; the Naildriver, 165 tons; and the Keystone, 55 tons. The Park-Utah property is making arrangements to produce. Development work at this property is being done through the Ontario drain-tunnel, and the ore will be conveyed to the station on the 1500-ft. level of the Ontario, then raised to the 600-ft. level, and transferred to the loading station for marketing. For more than 450 ft. a vein of first-class ore has been followed, ranging from 10 in. to 4 ft. in width. No stoping has yet been done, owing to shortage of men, and the ore that is accumulating in the bins came from development work. A force of men has been employed for some time enlarging the station on the 1500-ft. level of the Ontario, installing additional trackage facilities.

BRITISH COLUMBIA

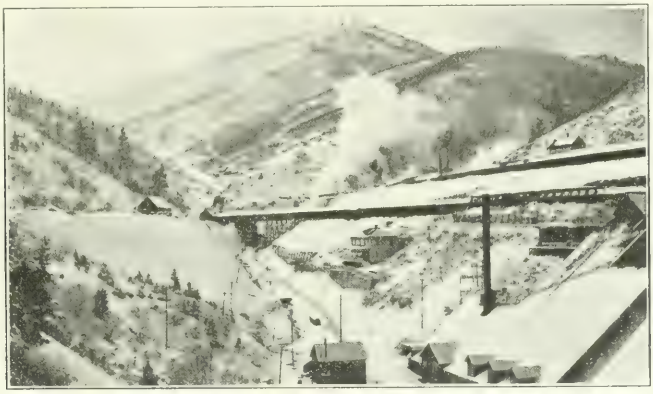
MANY CLAIMS HAVE REVERTED TO THE GOVERNMENT.

Trail.—The ore received at the Consolidated company's smelter during the last nine days of June amounted to 8755 tons, bringing the total for the half year up to 147,389 tons, of which only 3705 was in the form of concentrate. The first week of the new half year started well, 9036 tons of ore being received, of which 7231 tons came from the Consolidated company's own mines. The other shippers were: Bluebell, Riondel, 138 tons; Crescent, Greenwood, 2 tons; Emerald, Salmo, 47 tons; Electric Point, Washington, 133 tons; Florence, Princess creek, 35 tons; Josie, Rossland, 172 tons; Monarch, Field, 31 tons; Mandy, Le Pas, Manitoba, 1006 tons; North Star, Kimberley, 216 tons; and Sally, Beaverdell, 42 tons.

The Consolidated M. & S. Co. and 52 farmers have entered into an agreement to arbitrate claims for crop-damage to the farms supposedly due to smelter fume, and Judge Forin has been appointed arbitrator. Both parties to the pact have agreed that his decision shall be final. Under the agreement, the arbitrator has the power of awarding damages and also granting the smelting company a 'smoke easement' over the property and setting the value thereof. Should the arbitrator find that the damage from fume is so great that it is impossible to raise crops on any farm, he may decree that the smelting company shall purchase the property at a price he may set. Judge Forin is making a tour of the various claimants' farms and is accompanied by P. J. O'Gara, superintendent of the American Smelting & Refining Co.'s experimental farms of Salt Lake City, M. S. Middleton, formerly provincial horticulturist, who are acting for the company, W. J. Elmendorf, of Seattle, and W. H. Sleeman, of Annable, who are acting for the claimants, and

S. G. Blaylock, general manager for the company. Each claimant accompanies the party over his own property and points out damage that he believes to have been done by smelter fume.

Sandon.—Prospectors are active at this camp. Celano Polich is mining some good-looking ore from his claim and will ship a car of it to Trail this month. A tunnel is being driven in the Argo Fraction, better known as the Dutch Jake property. M. Byrnes is awaiting a run of water to clean up his placer claim on Carpenters creek. Spokane parties have bonded a number of properties at Zincton and will start development at once. Gus Foundry has struck some good milling ore on the Majestic group. J. P. Wilson has a good showing on the Hope group. George Dean has struck a new vein on the Cinderella group. The Silver Card Mining Co. has let a contract for 200 ft. of driving. Some good ore is being taken from the old Payne mine.



DALY JUDGE MINE, PARK CITY, UTAH

Ainsworth.—The New Canadian Metal Co. is unwatering levels 'B', 'C', 'D', and 'E' at the Blue Bell mine. These levels have been under water for two years, but the mine has been shipping steadily from the other workings. At the present time 45 men are employed at the mine, but this force will be increased considerably as soon as these levels are free from water and in condition for mining. The Nelson Iron Works built a special pump to unwater the mine.

Stewart.—During the winter the Premier mine shipped over 1500 tons of ore assaying about $275 per ton. But for labor troubles, which persisted during the greater part of the season, a much larger quantity would have been shipped. Besides the shipping-ore, a large amount of milling-ore was mined, and this has been placed on a dump, awaiting the completion of the new 100-ton concentrator, which, it is expected, will be started early in August. Considerable development work and diamond-drilling have been done, and the mine is reported to be in splendid condition.

Victoria.—Lists of Crown-granted mineral claims, which have reverted to the Crown because of non-payment of taxes and now are subject to lease under the terms of the Taxation Act, have been completed. This publication is of surprising size, containing more than 30 pages. Every district of British Columbia figures in the tables it contains. As would be expected the sections best known to miners, because they have been longest prospected and are yielding the bulk of the mineral for which the Province is responsible, have contributed to the Crown the greatest number of delinquent mineral claims. The Rossland district has provided somewhat over 800 such properties, all of which, as stated, may be leased after compliance with the statutory formalities, the particulars of which will be furnished on application to the Assessor. The Slocan district, also, is well represented with about 300 such claims advertised for lease. Nelson has about 328; Fort Steele about 90; Kettle River, 170. Many of these properties have not been sufficiently developed to conclusively prove their merit and probably will be further explored.

Alice Arm.—J. A. McLennan, of Vancouver, B. C., president of a company organized to develop certain mining property in this district, on his return from the North stated that work on the Royal group, adjacent to the Dolly Varden, was giving satisfactory results. He asserts that the vein of the latter mine has been found on the Royal group, that it has been traced for 400 ft., and that a tunnel has been started on the 600-ft. level where the vein is well defined. There still is snow in the gulches but the season may be said to have opened. Every train leaving Alice Arm is well filled with prospectors bound for different parts of the interior.

Silverton.—Louis H. Biggar, a flotation engineer of Montreal, claims to have developed a process for the treatment by preferential flotation of the silver-lead-zinc ore of the Standard mine. He now is engaged in the construction of a six-cell plant, which will be ready for operation soon. The process will be used first in the treatment of a 5000-ton slime-dump averaging 11 oz. silver,

3% lead, and 7% zinc, which was accumulated before the adoption of flotation at the Standard. As this material averages 50% through 200 mesh the only way the silver and lead can be separated from the zinc is by a process of preferential or selective flotation.

ONTARIO

McINTYRE COMPANY MAKES NEW HIGH RECORD OF PRODUCTION.

PORCUPINE.—Construction having been some time completed, the gold mines of this camp have settled down into a groove of steady production with comparatively few changes to report. The Hollinger Consolidated is treating about 1700 tons of ore daily, and no marked increase in this rate is anticipated for some time. Costs remain comparatively high, a recent increase having been made in the price of high-grade cyanide. The fiscal year of the McIntyre ended June 30 and forecast of the financial report indicates an income approximating $2,000,000 with net profits of over $1,000,000, constituting a new high record. Diamond-drilling at the Porcupine Crown has cut, on the 1100-ft. level, either a new vein or a faulted section of the orebody from which production so far has been obtained. The new discovery shows about five feet of quartz of similar characteristics to the main vein. Encouraging surface showings have been found at the Carveth property in Thomas township and the veins will be explored at depth by diamond-drilling before sinking is undertaken.

KIRKLAND LAKE.—The Teck Hughes is being operated to about two-thirds capacity with a force of 70 men, treating 2400 tons of ore per month. Underground work is mainly confined to the 400-ft. and upper levels, the ore at the deeper workings not being drawn upon. An important feature is the reduction of costs to approximately $6 per ton. Similar economies have been effected at the Kirkland Lake where the average of operating costs has been reduced to below $7 per ton. The physical condition of the mine is being rapidly improved. A raise has been made on a comparatively narrow orebody from the 200 to the 400-ft. level, and subsequent lateral work shows that the main orebody, 40 ft. wide in places, parallels this work at a distance of a few feet. The main vein of the Bidgood has been cut at the 200-ft. level where it has a width of about 15 ft. as compared with 12 ft. at the 100-ft. level. The shaft is being continued to a depth of 300 feet.

WEST SHINING TREE.—The Wasapika Consolidated announces that it is about to offer for sale 2,000,000 treasury shares of the par value of $1 at 10 cents per share "in view of the speculative nature of the enterprise". The company is capitalized at $6,000,000, $1,000,000 in shares of the former company having been exchanged on a basis of three shares in the new company for one in the old. A further $1,000,000 of shares were issued to finance the purchase of leases on three new claims lying to the north of the original Wasapika property and 2,000,000 shares were retained in the treasury. By the sale of these it is expected to raise $50,000 necessary for the installation of a mill capable of treating a minimum of 50 tons of ore per day.

FRONTENAC COUNTY.—The feldspar mining industry, the centre of which is at Tichborne, Frontenac county, in eastern Ontario, has increased considerably lately. Many new deposits of this mineral have been discovered and large shipments are being made to the United States. The Frontenac feldspar is regarded as superior in quality to that so far developed in other localities.

COBALT.—Increased activity is noted in the silver-mining areas of Northern Ontario, the field being again broadened by the success being obtained at Gowganda as well as South Lorrain. Prospectors are pointing to this as support to their earlier predictions that just as soon as interest became de-centralized and turned to the outlying fields, the likelihood of new producing mines would be strong.

Official advice from J. McIntosh Bell, who is in charge of the operation, confirms recent reports that success was being met in the development of the Keeley mine in South Lorrain. It is announced that silver ore to the width of three feet and averaging from 40 to 90 oz. silver to the ton has been found. This vein has been opened at the 230-ft. level as well as at a depth of 300 ft. While some of the richer shoots are yielding a fair amount of high-grade ready for shipment, the main output will be milling ore, the company now having an 80-ton mill in course of construction, which will be ready for operation by late summer or early fall. A shipment of between 10 and 11 tons of high-grade ore was made from the Castle property at Gowganda during the second week of July. The consignment was estimated to contain about $15,000. On the recently opened Colonial mine, at Cobalt, a rich shoot of ore has been found, and the indications are that this property will take its place among the regular shippers. The Colonial lies adjacent to the O'Brien, having similar geologic conditions and a number of promising veins already opened.

Work has been curtailed on the Walsh mines, at Gowganda, it having been decided to remove the plant to an island near the north side of the property where it is planned to sink a shaft and explore that part of the property lying beneath the lake. The mill on the Reeves-Dobie mine is being operated 20 hours daily. About 25 tons of ore per day is being handled. Plans are being made to enlarge the plant so as to treat about 50 tons. In June, the Nipissing mine produced $200,449. This compares with $335,597 during the previous month. For the first half of 1920, the Nipissing output is valued at $2,037,567, or at the rate of more than $4,000,000 yearly, as compared with $3,553,958 during 1919. Net profits for 1919 amounted to $2,717,312, from which fact it is estimated that 1920 profits will be still higher owing to the indicated increase in output of about $500,000. In addition to paying regular quarterly dividends of 5%, amounting to $1,200,000 annually, the company is expected to make annual capital reductions of $1,200,000, this being equal to $1 on each issued share.

CALIFORNIA

Downieville.—The greatest gold discovery for many years in this section has been announced by the Gold Exploration Co., operating the Comet mine in Jim Crowe canyon. The orebody is said to be 30 to 50 ft. wide and has been proved for a length of 200 ft. with no limit yet reached. Officials state that shoots of bonanza ore accompany that of mill-grade, and that a wide face of high-grade quartz has been exposed. Plans are being made to replace the present mill with a larger and more efficient plant and to carry forward mining operations on a larger scale.

Plumas County.—The freight rate on ore shipped from points in Plumas county to Wabuska, Nevada, a distance of 180 miles, now is $10.50 per ton, while the rate from the same points to Garfield, Utah, a distance of 680 miles, is $9.70. Several months ago the Interstate Commerce Commission granted reduced rates after a hearing in San Francisco, but objections were made by the Western Pacific company and the reduced rate was suspended. The Mason Valley Mines Co. is petitioning for a return to a lower rate, which will mean the resumption of operations at the smelter at Wabuska. The company also will begin immediately to develop and produce ore from properties it controls in Plumas county, it is said. Arguments are to be heard by an examiner of the Commission at Reno on July 26.

Sierra County.—The Twenty-One Mining Co. has sold all its mining property to the Sitxteen-to-One Mining Co. The deal marks the ending of bitter litigation, in which the Sixteen-to-One secured a judgment for $60,000 for ore extracted from its ground. The $60,000 judgment is a part of the purchase price, the rest being cash. The Twenty-One holdings consist of four valuable quartz mining claims, together with a ten-stamp mill and other surface improvements, and the Sixteen-to-One intends to operate through the Twenty-One tunnel, as well as through its own workings.

MISSOURI

Joplin.—Fire destroyed the roof, interior woodwork, and all of the bags at the bag-house of the zinc-oxide plant of the Metals Extraction Corporation at the State-line west of here on July 9, causing a loss of $10,000, which is covered by insurance. The fire started by sparks falling on a small frame building near the bag-house. The Galena fire-department arrived too late to prevent complete destruction of the interior bag-rooms. The walls and floors are of concrete and were not damaged. A force of men started immediately clearing away the debris and will re-build the interior of the house as quickly as possible. A metal roof will be put on the building to make it completely fireproof. The plant had been operating for several weeks in the manufacture of zinc oxide by a modified process. Two furnaces have been working, turning out from 7000 to 10,000 lb. of oxide per day, and other furnaces will be added soon to bring the output up to 70,000 to 80,000 pounds.

NEVADA

Contact.—Stockholders of the Seattle-Contact Copper Co. have received their first dividend checks. The company is shipping large quantities of high-grade ore by way of Rogerson.——At a recent meeting of the stockholders of the Javan Mines Co. a report was rendered by the general manager announcing a recent discovery of high-grade ore. Persons familiar with conditions in the company's workings predict one of the biggest producing properties in the Contact district.

Eureka.—More ore of shipping grade is now exposed in the Eureka-Croesus mine than ever before, and returns from the smelter on shipments sent out prove that material assaying $70 per ton is being mined from good-sized bodies in several places on the 400-ft. level. The company has been under heavy expense for the past two years in equipping the surface plants, purchasing freighting outfits, and sinking and drifting to reach and prove orebodies that were in the beginning believed, and later proved, to exist in the limestone below the old workings.——The Eureka-Climax is building a chute from the portal of the Mabel L. tunnel to a bin on the road about 40 ft. below, for storing the ore. The tunnel is being pushed through the Dead Broke claim.——The Eureka-Prince is drifting on the 150-ft. level, connections for air having been made with a winze above. The ore on this level is about three feet wide, mostly of good shipping grade. The gold content is high in portions of it, one sample of those assayed this week containing 5.2 oz., together with 248 oz. of silver, per ton. The ore is a brownish-black loosely-cemented lead carbonate, and while this assay cannot be considered representative of the orebody on this level, it shows that ore of exceptional value is being found.——The Eureka-Holly last month sent 300 tons of ore to the Utah smelters, the largest amount ever sent out from the mine in 30 days. All of this ore runs $75 per ton or more, and the same grade is being mined and hoisted daily, with the main orebody still averaging about 10 ft. wide.——The Ruby Hill is shipping ore as fast as cars are available, and rapidly completing pumping preparations on the 900-ft. level.

OREGON

Gold Hill.—The War Eagle Mining Co. has let a contract to W. H. Stickel of Gold Hill to burn 200,000 brick at the mine, 12 miles north of Gold Hill, to be used in the construction of a 30-ton Scott mercury-furnace. The property, consisting of 36 claims, known as the Utah group of mercury mines, was purchased by Salt Lake City men in 1915 from the original locators and later sold to the Seattle men who developed the property. The mine is equipped with two 12-pipe mercury furnaces with 10-ton capacity and has been a steady producer since 1915. The present equipment has been used only on high-grade ore, running better than 17%, but with the completion of the Scott furnace ore running as low as 2% can be reduced at a profit, with mercury selling at present prices of from $80 to $90 per flask of 75 pounds.

YUKON TERRITORY

Mayo.—There has been a stampede to a new strike that has been made near Mount Hinton, on the opposite side of Lightning creek to Keno hill and about five miles from it. Under the belief that it is an extension of the Keno Hill deposits, it is stated that claims are being staked all the way between the two deposits. Ore running from $1000 to $2000 per ton is being taken from some of the Keno Hill prospects. In one instance a five-foot vein has been stripped for more than 200 ft., and is said to carry more than 1000 oz. in silver.

ECONOMICS AND GOLD MINING ON THE RAND

At the annual meeting of the Crown Mines company at Johannesburg, on June 17, the chairman, Mr. Samuel Evans, said that the net premium on gold produced this year from January to May totaled £292,000, which was equal to 21s. 1d. per ounce, or 7s. less than the increase in costs per ounce since 1913.

The working costs were now considerably higher than they had ever been, owing to increases in wages to white labor, stores, and other costs. White wages show an increase this year of 69% on the 1915 figure, when 103,000 more tons was milled. The average monthly earnings of the European workers have gone up from £24 6s. 10d. per month to £40 1s. 7d., an increase of 64.6%. Stores show an increase of 33%, and other costs 36%, as compared with 1915. Reverting to the working costs, Mr. Evans expressed the view that the increases were due mainly to the replacement of gold by paper for currency purposes in South Africa and elsewhere. The index numbers showed that the purchasing power of gold in England was now rather less than half of what it was in 1914. It had not diminished in the same ratio in South Africa, as they started at a different level. Taking everything into consideration, it was not an exaggeration to conclude that had the commodity value of gold remained stable since 1896 the mines of the Rand would be working today at a cost averaging something well under 12s. per ton, compared with 22s. 9d. last year and a much higher figure now.

Notwithstanding the example of England, where an effort was being made to keep paper money within bounds, the banks in South Africa had been issuing paper money at an accelerating pace. On the outbreak of the War the banks had £2,150,000 in circulation in South Africa. During the War they issued an additional £4,000,000 worth of notes, and since the Armistice they had added £3,500,000 to the paper circulation of South Africa. He was afraid that the dangerous character of the action of the banks was not appreciated by the Government and Parliament. Instead of taking prompt and effective steps to make an end as quickly as is safely possible to the senseless creation of artificial buying power, it appeared that serious consideration was being given to measures which, if adopted, would almost certainly have the effect of further disturbing the currency and plunging South Africa deeper into the paper-money bog. It hardly seemed a sane policy for the Parliament of the largest gold-producing county in the world to enact laws encouraging and facilitating the supersession of gold by paper.

If the majority of the mines on the Rand were to be kept working, not only must the upward movement of prices be arrested, but there must be a reduction in prices, and that could only be accomplished by limiting and diminishing the supply of paper money. He spoke strongly, as he felt there was a real danger that in order to give temporary relief to the banks and the wool and other interests Parliament might adopt a course which was bound to terminate disastrously, however promising it might appear now. The afflictions caused by the excessive issues of paper money could only be made worse by further issues. In spite of the menacing character of the immediate outlook in South Africa, he was disposed to take a more optimistic view of the gold-mining industry than was usually held. Many people, even among the leading economists, believed that paper money had come to stay, and that the commodity value of gold would remain at a permanently lower level than in 1914. The experience of France under Napoleon justified the conclusion that the countries which first completely abandoned paper money and returned to specie payments would be the first to recover their prosperity, and that their good fortune would force the others to do likewise. He looked forward to a similar outcome at the present time.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

D. D. Moffat is at Los Angeles.

W. J. Loring is in Washington, D. C.

C. W. Purington writes from Kobe, Japan.

James S. Douglas was in the Ray district last week.

Bond Coleman has moved from Zacatecas to Mexico City.

E. D. Bullard Sr. arrived last week from the East, where he has been for two months.

Arthur Mort passed through San Francisco on his way from Beluchistan to London.

Hugh B. Lowden, of the Colorado Iron Works, Denver, was in San Francisco this week.

Harold A. Linke, mining engineer of Salt Lake City, is examining lead-silver properties near Hailey, Idaho.

Frederic R. Weekes has returned to New York from a six weeks professional trip to Montana and California.

Hilding Magnusson, mining engineer for a large steel company in Sweden, spent a week in Utah recently.

W. S. Boyd, manager for the Ray Consolidated Copper Co., was in San Francisco and Salt Lake City recently.

Warren D. Smith sails on the 'Shino Maru' for the Philippines, where he is Active Chief of the Division of Mines.

J. Walter Beam, superintendent of the Benguet gold mine near Manila, P. I., is visiting at his old home in Salt Lake City.

Henry W. D. Hayden, recently acting superintendent of the Suan mill, at Holkol, Korea, has returned to San Francisco.

H. C. Goodrich, chief engineer for the Utah Copper Co., and **George C. Earl**, assistant mine engineer, are in San Francisco.

J. B. McIntosh, of Salt Lake City, has gone to Pachuca, Mexico, to accept a position with the United States Smelting, Refining & Mining Co.

Guy C. Riddell, formerly adviser to the U. S. Tariff Commission, is now consulting engineer to the Wah Chang Trading Corporation in New York.

Howard A. Eavenson has resigned as chief engineer to the United States Coal & Coke Co., to open an office as consulting mining engineer at Pittsburgh.

E. A. Holbrook, superintendent in charge of the Pittsburgh experiment station of the Bureau of Mines, has been appointed Assistant Director of the Bureau.

H. S. Weigall has been demobilized with the rank of Major and has returned from England to Korea as assistant general manager for the Seoul Mining Company.

Lester S. Grant, Professor of Mining in the Colorado School of Mines, has motored from Golden to San Francisco, visiting various mining districts on the way.

Walter A. Scott, formerly counsel for the Butte & Superior Mining Co. and other defendants against Minerals Separation, now living at Los Angeles, was in San Francisco this week.

Rudolf Gahl has been retained by the Cerro de Pasco Copper Corporation as consulting metallurgist in connection with its milling projects and sailed for Peru from New York on June 30.

Jackson A. Pearce, who is now with the Compagnie du Boleo, in Baja California, was in San Francisco recently and testified before the Federal Trade Commission in the Minerals Separation affair.

A. G. Burritt, geologist of Salt Lake City, has recently returned from northern Mohave county, Arizona, near St. George, Utah, where he has examined promising oil lands. He is now at DeBeque, Colorado, for a few days.

THE METAL MARKET

METAL PRICES

San Francisco July 20

Aluminum dust, cents per pound	65
Antimony, cents per pound	8.50
Copper, electrolytic, cents per pound	19.00
Lead, pig, cents per pound	8.25—9.75
Platinum, pure, per ounce	$85
Platinum, 10% iridium, per ounce	$118
Quicksilver, per flask of 75 lb	890
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

July 19.—Copper is steady and quiet. Lead is inactive but strong. Zinc is dull but firm.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid $1 per ounce for all silver purchased by it, fixing a maximum of $1.01½ on August 15, 1918, and will continue to pay $1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine) calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
July 13	93.50	53.62	June 7	98.23	56.52
" 14	93.00	53.75	" 14	86.00	48.02
" 15	92.25	53.62	" 21	87.07	48.73
" 16	90.35	52.50	" 28	91.41	51.69
" 17	92.12	52.00	July 5	89.97	51.68
" 18 Sunday			" 12	92.18	52.66
" 19	88.75	52.00	" 19	91.04	52.91

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	....
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	....
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound

Date		Average week ending	
July 13	19.00	June 7	19.00
" 14	19.00	" 14	19.00
" 15	19.00	" 21	19.00
" 16	19.00	" 28	19.00
" 17	19.00	July 5	19.00
" 18 Sunday		" 12	19.00
" 19	19.00	" 19	19.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	....
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	....
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
July 13	8.40	June 7	8.68
" 14	8.40	" 14	8.75
" 15	8.45	" 21	8.21
" 16	8.50	" 28	8.15
" 17	8.50	July 5	8.39
" 18 Sunday		" 12	8.25
" 19	8.50	" 19	8.45

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	....
Feb.	7.07	5.13	8.88	Aug.	8.05	5.78	....
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	....
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.88	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
July 13	8.20	June 7	8.02
" 14	8.25	" 14	8.00
" 15	8.25	" 21	7.79
" 16	8.25	" 28	7.85
" 17	8.25	July 5	8.04
" 18 Sunday		" 12	8.15
" 19	8.25	" 19	8.24

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.58	7.44	9.56	July	8.72	7.78	....
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	....
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Date	
June 22	85.00	July 6	90.00
" 29	85.00	" 13	85.00
		" 20	90.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	....
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	....
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	....
Apr.	115.00	73.15	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

INTEREST RATES AND DEFLATION

The subject of interest rates is one that is of vital importance [illegible] to bankers but to every business man and to the community at large. The bank's profits depend largely upon the return received for the use of its money and the merchant's welfare and success depend to a great extent upon his ability to borrow from the banks at as low a rate as possible, according to the Chemical National Bank of New York. Recently, and in fact during most of this year, the papers and financial magazines have been setting forth the advantages and disadvantages of inflation and ruminating upon the apparently ever-increasing rates for the use of money. To the unmitiated or to those who have not had the opportunity to study the subject, it may seem almost unbelievable that interest-rates could go higher than 6%, which is generally thought to be the maximum. These persons fail to take into account the fact that money is a commodity, the same as wool, meat, or anything else, and its value depends upon the old law of supply and demand. It is, therefore, no more possible to set a maximum figure for which money can be loaned, and have interest rates remain at that figure, than it has been to set a maximum price for sugar, which recently, due to an actual scarcity, has reached a price never before equaled since the Civil War. During the recent war the Government had the power to fix the prices of certain commodities, but this was merely a temporary measure and was not based upon the law of supply and demand.

The Federal Reserve banks, through a policy of higher re-discount rates, have recently inaugurated a period of deflation which is well under way. Had the era of inflation been allowed to make greater headway, the result might have been a panic, but, an orderly re-adjustment is now in progress.

One of the principal reasons for putting an end to inflation was to bring about lower prices. There is no need of explaining that commodities of all kinds have recently reached figures quite out of proportion to the average person's pocketbook. One way of bringing about lower prices would have been to increase production, when prices would naturally fall. But, with the laboring class demanding shorter hours and no one willing to work on our farms, greater production has not been possible, at least for the present. The other method of lowering prices, at least to some extent, is that of decreasing consumption. A combination of both methods would probably be the most desirable, but since this could not be had, it is evident that the latter method was the one to be followed.

The result of the Federal Reserve Board's policy of deflation is already apparent and, while the process may be unpleasant for the time being, there is no doubt but what the outcome will be of benefit to all. As long as the merchant uses his own money for speculative purposes there is no great objection, but when he speculates with his bank's money, resulting in generally increased prices for commodities, there is no question but what the wrong policy is being pursued. Money today is scarce, but there is plenty for legitimate business needs.

While the Federal Reserve banks probably took the first actual step in the process of deflation, the situation has been more or less affected by the outlaw railroad strike, the results of which have recently become more apparent, with deliveries of merchandise held up at all points. There is a vast amount of 'frozen credit' which cannot be released until there is a free movement of goods. Merchants and manufacturers awaiting delivery of goods have, therefore, been obliged to borrow very heavily from the banks. Until there can be prompt liquidation of such credits, the increase in the discount rates adopted by the Federal Reserve banks can be of little effect except to check [illegible] business.

Another instance of the scarcity of money is the fact that the Treasury of the United States, when seeking $400,000,000 a few weeks ago, was obliged to pay the highest interest charge in half a century. The new treasury certificates bear 5¾% and 6% interest and the Secretary, with the combined wisdom of the other treasury officials, evidently believed that high rates at least will prevail for a year. The ultimate aim of all remedies for inflation is to reduce the high cost of living, and every effort toward that end should be made, but just as long as there is an actual shortage of goods and labor insists on a short day of inefficient work, we cannot expect permanent results.

MONEY AND EXCHANGE

Foreign quotations on July 20 were as follows:

Sterling, dollars:	Cable	3.84
	Demand	3.83
Francs, cents:	Cable	5.89
	Demand	5.75
Lire, cents:	Demand	2.60
Marks, cents		[illegible]

Eastern Metal Market

New York, July 14.

There is a better tone to all the markets but business is not heavy. Prices are firm to higher.

Inquiry for copper is reported as considerably improved and the tone of the market is stronger.

The market for tin is quiet with the light transactions confined to dealers. Spot Straits is nominal.

Conditions in the lead market are but slightly changed.

The tone of the zinc market is strong with the price tendency upward.

The antimony market is quiet and unchanged.

IRON AND STEEL

Against the protests of iron and steel producers the Interstate Commerce Commission has extended for 30 days from July 21 its order confining the use of open-top cars to coal. It remains to be seen how far the shut-downs, that steel companies said were inevitable, will go. Some relief is given by exempting from the order all flat-bottom gondola cars or cars which on June 19 had been definitely taken from coal-carrying service, this being one modification asked by iron and steel interests.

So far as the merchant pig-iron trade is concerned, the soaring of fuel prices has caused as much concern in the past week as the car troubles to which high prices for fuel is chiefly laid. There is an urgent call from some quarters for a return to the Government control of fuel that was given up on April 1, producers of pig-iron viewing with dismay sales of prompt coke at $19 this week, while bituminous coal has brought from $10 to $12 at the mines.

In the Pittsburgh district more steel-making and finishing capacity has been idle or has run intermittently this week than in the preceding week. Two large steel-pipe works which closed down July 3 have not yet resumed.

Soaring fuel prices are playing havoc with cost-sheets. In the case of a large steel interest the advance in June was between $1.50 and $2 per ton.

Export business keeps up on a good scale. Some irregularities in prices have resulted from the re-sale of material bought from Japan, but the tonnages are not significant. A 5000-ton ship-plate order for export was placed at 3.75c., Pittsburgh.

COPPER

The tone of the market is reported as considerably improved. There is a good deal more interest from consumers, although this has not yet developed into business. Sales, however, both for domestic and foreign account, continue satisfactory and prices are firm. It is reported that offerings in the outside market have been pretty well absorbed and that prices there are firmer. An interesting statement is to the effect that consumption of copper at present is "enormous, running into 60,000 net tons per month". It is certain that this is in excess of production at present. Prices of the leading producers continue firm at 19c., New York, for both Lake and electrolytic copper at which sales have been made for prompt delivery and into the third quarter. In some cases transactions for delivery in October are also made at correspondingly higher prices. There are offerings in the outside market at 18.75c., New York, but purchases can be made at 18.50c.

TIN

This market has been lifeless and quiet the last week. Consumers continue to hold aloof. Some dealers could have been buyers at prices somewhat below the market but sellers have been indifferent. As a consequence total sales have been light and spot Straits continues in light supply and prices are nominal. On the New York Metal Exchange, total sales last week were around 200 tons, nearly all future shipment, at prices ranging from 47c. to 50c., depending on the position. Late last Friday one dealer reported an active inquiry for 300 to 400 tons, but aside from this there was little of interest. The same conditions have prevailed thus far this week. Spot Straits yesterday was quoted at 50.25c., New York, but largely nominal. In London yesterday spot Straits was quoted at £281 per ton, against £259 a week ago. Spot standard tin was quoted yesterday at £260, the spread between the two being due to the scarcity of Straits tin. Arrivals thus far this month have been 1730 tons, with 5430 tons reported afloat.

LEAD

Basic conditions in this market as discussed a week ago are but little changed. There is some demand for prompt metal, but the scarcity makes it difficult to obtain. Some has been sold, however, for quick shipment at the equivalent of 8.65c., New York, and there was also a sale of early August shipment at the equivalent of 8.45c., New York, but the total in both cases was not large. Without doubt more could have been sold had there been sellers who possessed the metal. The leading interest is apparently not selling, and hence its quotation of 7.75c., St. Louis, or 8c., New York, is nominal. In the outside market quotations may be conservatively put at 8.15c., St. Louis, or 8.40c., New York, for early delivery.

ZINC

There has been little change in this market during the week. Demand continues moderate and prices firm, with the tendency upword. Prime Western for third quarter delivery is quoted at 7.85c., St. Louis, or 8.25c., New York, while for July 7.90c. to 7.95c., St. Louis, has been realized. The fact that production is curtailed, as noted a week ago, and that producers are fairly well sold for July, makes for a technically firm, to strong, market. Producers are at least not inclined to quote beyond July.

ALUMINUM

Demand is light and quotations are unchanged at 33c., New York, for wholesale lots of virgin metal for early delivery by the leading producers, and at 31.50c. by outside sellers. The former quotation is nominal.

ANTIMONY

The market is quiet and unchanged at 7.50c. to 7.75c., New York, duty paid, for wholesale lots for early delivery.

ORES

Tungsten: The market is exceedingly quiet and devoid of features. Prices are nominal at $6.50 up per unit in 60% concentrate, depending on the grade of ore.

Ferro-tungsten is quoted at 85c. to $1.05 per pound of contained tungsten.

Molybdenum: Conditions are unchanged and prices are nominal at 65c. to 75c. per pound of MoS_2 in regular concentrate.

Manganese: The market is quiet with prices firm at 70c. to 75c. per unit for high-grade ore. The largest consuming interest has contracted for about 20,000 tons per month of Indian ore for delivery in the next year.

Manganese Alloys: Production of ferro-manganese in June, according to the blast-furnace reports of 'The Iron Age', was 26,265 gross tons, which is larger than for any other month this year or in 1919. Prices continue firm at $200 per ton, delivered, for the last half and $225 for spot. Some British alloy is available at $195, seaboard, for shipment from August on. Demand is light and sales are confined to small lots for early shipment. Spiegeleisen is quiet and firm at $75, furnace, for prompt and early delivery.

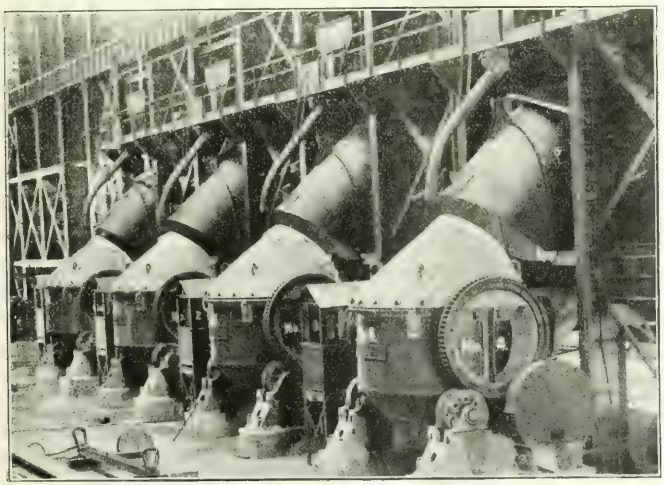
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

COPPER-CONVERTERS AT CLARKDALE, ARIZONA

The accompanying illustration shows the copper converters at the smelter of the United Verde company at Clarkdale, Arizona. They are made by the Allis-Chalmers Manufacturing Co., being the standard vertical or 'Great Falls' type of machine.

In this type of converter the shell is made of heavy steel plates, with two cast-steel trunnions riveted on, one of which is fitted with a removable cast-steel riding-ring and the other with a cast-steel removable riding and gear-ring. Both trunnions are rough-machined on the inside to give a perfect bearing on the steel shell, in exact alignment with the centre line of the shell, carrying rings and driving gear. Where the tuyeres enter the shell it is reinforced by a heavy steel plate. The hood or top half of the shell is made in one piece of cast steel and is bolted to a heavy cast-steel reinforcing angle, which is riveted to the upper part of shell. Lifting lugs are riveted to the shell and cast integral with the hood. One of the trunnions is provided with an opening for the passage of the blast, and arranged to connect with a cast-steel or cast-iron wind-box; the wind-box being held by a bracket secured to the shell. A sheet steel shield is secured to the shell, to prevent accumulation of slag on top of wind-box. The shell is provided with individual tuyeres and ball-valves both of which can be removed easily. The tuyere-bodies are made of cast-iron with covers of cast-steel. The ball-valve is held in a suitable casing, cast integral with the cover of each tuyere, from which it can be removed or replaced by taking off the tuyere cover. The tuyere-bodies are arranged for fastening to the bottom of the wind-box with brass sleeves and coupling nuts, forming an air-tight connection. The tuyeres are made of extra heavy pipe, of proper length to extend into the shell and through the lining. At a point where the tuyeres enter the shell, a flange or stuffing-box for each tuyere is attached to the shell and arranged for retaining a suitable packing around the tuyeres, so that the joint will be air-tight. The lower end of the tuyere bodies are attached to a steel bar, to keep the tuyeres in proper alignment. A flexible blast-connection is attached to the trunnion, which allows the shell to rotate and admits of any slight difference in alignment between the shell and the blast-pipe. For controlling the blast a lever-operated quick-opening gate valve is supplied. The stationary part of the blast-connection is supported by a standard having bolted connection on one end and a ball-support on the lower end, which fits into a spherical socket on a bracket attached to the roller frame. The converter-shell is supported on two stands, one placed at each end. These stands are of heavy deep-box section, strongly ribbed, having suitable bosses for foundation-bolts. The angle roller-bearings mounted on these stands are securely bolted to same and are provided with large grease-pockets and cups for lubrication. The stand at the driving end has cast integral therewith an extension which forms the base for supporting the worm, worm-shaft, and bearings for same. There are four cast-steel supporting-rollers on which the shell is rotated. Two have plain faces, to permit lateral movement of the converter, due to expansion. The other two are flanged to suit the combined riding and gear ring. The supporting roller on the driving shaft is a combined carrying roller and spur pinion, having the bottom of the gear between the teeth cast open, to avoid binding of the gear and pinion-teeth. The other flanged roller has two turned faces for the riding-ring and a recess into which the gear-teeth pass; the driving is done entirely from the shaft on which the worm-wheel is mounted. The supporting rollers are mounted on heavy forged-steel shafts. The converter-shell is tilted by means of a worm-wheel consisting of a cast-steel spider fitted with a removable bronze rim accurately machined. A forged-steel worm is provided which is accurately machined and mounted on a steel shaft which is coupled to the motor. This worm-shaft is fitted with a compression coupling by means of which it can be disconnected from the motor shaft, in order to allow of withdrawal of the worm and shaft from the casing. The worm-wheel is surrounded by an oil-tight sheet-steel housing, which is fitted to the inside of the worm-box. This housing consists of an upper and lower half and a removable cover on the outer side, giving access for inspection and repairs. The tilting mechanism is operated by



Four 12-ft. 'Great Falls' Copper-Converters at the United Verde Smelter

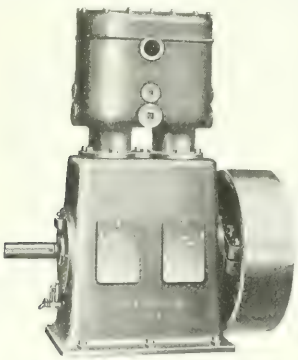
either a direct or alternating-current, variable-speed, back-geared motor of the well-known Allis-Chalmers type, especially designed for this service.

For operating the motor, a reversible 'drum type' controller and 'grid type' resistance are provided. There is also provided a solenoid brake for automatically stopping the machine at any time when the current is shut off. The motor and solenoid brake are covered with a sheet-steel housing, provided with two sliding covers for inspection, which are easily removed. A storage-battery safety system, which automatically takes the control from the operator in case of failure of electric current, and rotates the converter to a 'safe' position, should the tuyeres be submerged when such a failure occurs, can be supplied with the converter.

NATIONAL AIR-COMPRESSORS

Air-compressors, in sizes from ½ to 150 hp., are being manufactured in Los Angeles by the National Compressed Air Machinery Co. The compressors are constructed in two general types; the single-cylinder Class 'S' machine is for light work; the two-cylinder Class 'D', 'D2S', and 'DVL' are designed for those whose requirements are greater. The duplex types are made in a wide variety of sizes and for pressures of from 10 to 500 lb. per square inch. The leader in the duplex type is the Class 'D', two-cylinder, single-stage, single-acting, as illustrated in the accompanying cut.

Some of the features that distinguish this machine from other makes that look about the same are as follows: The main bearings are three in number, all adjustable by the removal of laminated shims, and any one removable without disturbing any other. Equally important these bearings are carried on heavy bridges cast in the main frame. The cross-head guide is free from stuffing-box troubles and the cylinder walls get no side-thrust wear. Lubrication is by splash only. There is not a lubricator, oil, or grease-cup on the compressor. The cylinder wall lubrication is controlled by the apron, on the piston, dipping into a groove kept filled with oil by the cross-head. Enough without too much is the answer to the cylinder-lubrication problem in this design. National arch-disc valves are used in all National air-compressors. They are guaranteed for two years against breakage in use. Inlet and outlet valves are interchangeable. They are a happy medium between the old, self-destructive poppet valves, and the host of frail, and in many cases complicated, so-called plate valves. While being efficient and silent, they stay tight and they 'stand the gaff'. There are no extra parts, such as buffers, stop-plates, guides, or washers. For each valve there is but one spring, one cap, and nothing else. Both the single and two-cylinder are furnished bare, or in complete assembled outfits, including motor or engine drive, pressure-unloader, and electric, pneumatic, or other types of control, as best suits the user's conditions.



Class 'D' National Air-Compressor

SIMPLE DEVICE FOR STRIPPING OUT INNER STRAND OF STEEL CABLE

An interesting salvaging operation was recently carried out successfully by the Spanish-American Iron Co., a subsidiary of the Bethlehem Steel Corporation, in Cuba. The inner strand of a three-inch steel cable which had been condemned and discarded because of worn and frayed outer strands was salvaged and the worn strands cut into six-foot lengths for the charging-box. Both the inner strand and the scrap were well worth saving, as the cable was a mile and a quarter long and the reclaimed strand (1¼ in. diam.) was practically as good as new.

The problem involved was to cut away the six worn strands without damaging the valuable inner strand. This was accomplished by means of a simple but ingenious device constructed on the ground out of scrap material. Suitable lengths of iron pipe, of a size convenient to grip with the hand, were oxwelded into the rim of a small iron pulley in such manner as to resemble spokes of a wheel with the tire and felloes missings. A short section of sheet-iron pipe, slightly smaller in diameter than the pulley but larger than the shaft bore, was then welded to it in line with the bore by the use of four strips of strap iron.*

The strands of the cable were then pried apart for a few feet to admit of passing the inner strand through the hub and its extension, and the feeding of the outer strands through the six spaces between the spokes. With the strands so adjusted the device was revolved against the wind of the cable and advanced as the strands unwound, the inner strand being allowed to lie in a continuous length along the course of the work and the worn members being easily cut into the proper lengths with the oxy-acetylene torch. The length of the spokes gave the necessary leverage for operation of the device by hand. The cable, of course, remained stationary, the inner strand being coiled and the scrap collected after the work was completed. The job was done in jig-time, the oxy-acetylene flame snipping off the worn strands with almost chopping speed.

The use of the oxy-acetylene cutting, which was done with a portable Oxweld outfit, made simple and inexpensive an operation that would have been prohibitive by any other mechanical means, as it was equally out of the question to carry shears of sufficient power to the work or to convey the work to the shears. Thus the salvaging was accomplished with dispatch and economy, netting the owners of the cable a handsome profit on material that could not have been profitably reclaimed by any other process.

The Molybdenum Corporation of America, having the same executive and operative personnel as that of the Electric Reduction Co., announces that it has acquired as of July 1, 1920, the plant, equipment, and operations of the latter company at Washington, Pennsylvania, together with molybdenum mines in New Mexico. This company will continue to furnish ferro-tungsten, ferro-molydbenum, and other high-grade ferro-alloys, metals, and chemical products with no change in policy whatever. Having now direct control, from the crude ore to the finished material, the Molybdenum Corporation of America is in position to render exceptional service in supplying molybdenum products.

*The use of the pulley and pipe-extension was necessary only because a suitable length of pipe was not at hand. A single section of pipe of the right size to allow for welding in the spokes and long enough to keep the inner strand from curling would be much simpler and would answer the purpose equally as well.

T. A. RICKARD, - - - - Editor

RESUMPTION of trade with Russia will include the shipment of a product for which there is no demand in the United States, namely, Bolshevists. The removal of commercial restrictions will render practicable the deportation of about a thousand 'Reds', from Russia, Esthonia, Finland, and other parts of what was formerly known as the Russian empire. It is stated that a number of these anarchists are out on bail, on account of the embargo against American ships entering Russian ports. That embargo is now lifted. We hope the departure of the undesirables will be expedited and that more care will be taken to prevent them or others like them from re-entering this country.

IN the course of expanding its bureaucratic organization at Washington, the American Mining Congress has decided "to create a tax division under the direction of a man who has given tax matters thorough and careful consideration, and who will be in a position to render assistance to both the Government and the tax-payer". One would think that among the 35,000 employees in the Treasury department there would be a man "who has given tax matters thorough and careful consideration", such consideration as would enable him to arrive at an intelligent decision in difficult cases. Either the Treasury department is ridiculously inefficient, despite its huge payroll, or else the Mining Congress is adding to its organization needlessly.

WILD-CATS wearing an engaging smile, like the proverbial Cheshire feline, are as numerous in Australia as in the United States. We have read recently a description of a remarkable mineral deposit at Miva, in Queensland, where an "unlimited" tonnage of ore assaying 73% iron has been uncovered. This ought to be enough for one story, but we are told by the irresponsible scribe that "oxide of iron and white and red lead of good quality have also been found in fair quantities, and gold, the assays yielding 15 dwt. and 9 dwt. respectively of the latter metal". Evidently all that is needed now is an oil-well in juxtaposition; then with one product the good people of Miva can paint things red and with the other they can whiten a reputation darkened by such divagations from the truth. We are reminded of the deposit of soapstone that was found in the sagebrush desert many years ago and was described as "natural soap", useful for removing stains from the escutcheon of the State of Nevada, which at that time had become somewhat besmirched by the fiscal activities of Graham Rice and other peddlers of wild-cat scrip.

DANIEL GUGGENHEIM has 'called the turn', as they say, more than once, so we note with pleasure his statement, made just before sailing for Europe, that "there is absolutely nothing in the present situation to justify any pessimism". Presumably the cost of sugar or of gasoline does not worry Mr. Dan. as it does some of the rest of us. In regard to the metal markets, he says: "The clearing up of the foreign exchange situation and financial readjustment on the part of European countries will materially relieve present uncertainties. We are now marking time, but I wish to emphasize that there is nothing to justify any pessimism." He says it twice, so he must mean it. His opinion on such matters is usually well founded.

EIGHT editors are needed to prepare the weekly output of our contemporary at New York, so its editor-in-chief states in the latest issue to hand. We have three editors on our staff, one of whom, we regret to say, has been absent on sick leave for five months. The two salute the eight! The editor in New York explains that "the editorial which you find so punk or offensive is the work of the jail editor". We have noticed no editorials that were offensive; but as to the jail, we are reminded of the lady who showed her new maid a room and explained that it belonged to her son, "who is at Yale", she added. Whereupon the Swedish damsel replied that she also had a brother "in yail; he got to stay there 60 days". We hope the gentleman in New York, and probably from Columbia, will retain his dangerous post for more than 60 days and enjoy his sentences.

WE take pleasure in publishing a scholarly article, on the relation of science to industry, by Mr. A. W. Allen, who, just now, is in Chile. He makes a plea for scientific research as the handmaid of industrial development, and he does it in terms that will enlist the interest and sympathy of all thoughtful citizens. It is well occasionally to look beneath the surface of things and remind the community of its obligation to science, and of the need, if only on account of enlightened selfishness,

to foster the investigation of those basic principles, in chemistry and physics more particularly, upon which, for example, the progress of mining and metallurgy depend. Mr. Allen does that for us effectively, illustrating his argument by reference to the story of the cyanide process and the function of oxygen in precipitation. The recent disorganization of the Geological Surveys of both the United States and Canada by reason of the inadequate pay allowed to those engaged in an important phase of scientific research, is another illustration of a condition to which it is well to draw notice at this time.

THE La Rose Consolidated Mines Company has started legal proceedings to compel the Mining Corporation of Canada to compensate it for the old tailing from the La Rose ores treated in the Northern Customs Concentrator that is now being re-treated by the Mining Corporation. Tailings derived from ores from various mines were impounded without attempt at segregation in the bed of Cobalt lake. The defendant company in the present action is obtaining a profit from re-treating the old tailing with which is intermingled some from the La Rose ore. The plaintiff contends that it is still the owner of the residue from the first treatment and is entitled to a share in any profit that may be won. Without knowing exactly the particular circumstances under which the Mining Corporation acquired its interest in the tailing, we are unable to present its side of the controversy, but the search for an equitable basis for settlement offers an interesting problem.

NEW regulations covering the leasing of phosphate lands have been issued by the Secretary of the Interior under date of May 22, yet the local land-offices, we are informed, have as yet received no copy of them; meanwhile they have been authorized to accept applications for lease, but not to transmit them to Washington. This suggests a curious failure to connect. These new regulations specify a minimum royalty of 2% on the gross value of the output, but they fail to state the maximum royalty, or indeed to indicate at what figure the royalty will be fixed. Of the annual "investment" on the lease, meaning probably the money spent, not less than one-third must be expended in actual mine development, "and a like amount each year for the two succeeding years", so that evidently in the two succeeding years not the ratio but the amount governs. Each lease will contain "approximate conditions fixing the minimum production of phosphates or phosphate rock from the land". Are 'phosphates' and 'phosphate rock' synonymous? The regulations are poorly worded and obscure.

EXPORTATION of gasoline from the port of San Francisco is increasing steadily while the shortage of motor-spirit is causing growing perturbation. During the first four months of 1918 the export of oils, including gasoline, amounted to 65,136,601 gallons valued at $2,291,294; in the corresponding period of 1919 the total was 43,722,630 gallons valued at $1,714,766; from January to April inclusive of this year it was 100,444,971 gallons valued at $3,929,302. Last year 83% of the oil exported from this port went to Canada; this year, 48.62% had the same destination, and 35.74% went to Chile. In May the export of gasoline reached 4,342,270 gallons, and it was then that the people of California were told that there was a severe shortage, so that they must be content with five gallons at a time. In June the export of gasoline from San Francisco was 4,585,227 gallons, worth $1,401,731. This does not mean much unless compared with the consumption of gasoline in California, which has averaged 20 million gallons during the first five months of this year. Obviously if 20 to 25% of our output goes abroad, the domestic price is bound to be excessively high.

DIVIDENDS distributed by the gold-mining companies of the Witwatersrand for the first half of the current year aggregate £3,102,975, which compares with £2,576,000 for the first half of 1919 and £3,872,000 for the second half of last year. It must be noted that it is the custom to make a special distribution of profit at the end of the year, so that a comparison between the first half of 1920 and the second half of 1919 would be misleading. As against the corresponding period of 1919, the first half of the current year shows an increase of £526,975 in dividends. This is encouraging, but it is not as much as was to have been expected, having regard to the premium on gold. The amount of gold produced in the respective first half-years has been about the same, while the gross increase of revenue due to the premium has been fully £4,000,000 more during the first six months of 1920 than during the same period of 1919, so that, evidently, nearly seven-eighths of the premium has been wiped out by the increase of expenditure in other directions. Higher wages, the advance in the price of supplies, and banking charges have done their deadly work to a distressing degree, from the shareholder's point of view.

IN a recent dispatch from Philadelphia we read: "Anthracite operators regard $3.34 per day as a sufficient wage to enable a common laborer in the mines to support himself and family". If by "to support" is meant to purchase food containing the calorific value required to sustain life regardless of quality and variety; and to provide garments capable of preventing death by freezing; and to rent and heat a structure large enough and whole enough to serve as a place to eat and sleep, with no consideration of healthfulness, not to mention comfort or convenience; if these things are what the operators conceive as constituting "support", then $3.34 per day may be enough. However, had this been their idea, there would have been no point in specifying "for a common laborer" with respect to these essentials to living under the economic conditions of today. A 'common' capitalist would require less than a common laborer because he would need less food; neither he nor his wife do as much work and they could accordingly

get along with a lighter diet. It appears, then, that this $3.34 is presumed to supply such degree of comfort as, in the eyes of the anthracite producers, a laborer may reasonably expect. They believe, apparently, that it should enable him to purchase the things that make living something more than mere existence; that it should give him such an outlook on life as to make American citizens out of him and his children. We do not believe $3.34 is nearly enough; nor do we think that the operators who make the statement really believe it is enough. When they make such a statement they invite bitter and justifiable resentment.

THE Joint Conference Committee of the four Founder Societies, which originally constituted Engineering Council, has issued Bulletin No. 1, in which it corrects certain misapprehensions regarding the recently launched Federated American Engineering Societies. The bulletin points out that the administration of the new organization is to be entrusted to American Engineering Council and that the latter is essentially a perpetuation of Engineering Council as it now exists. The suggestion that "no specific business is yet outlined for action by the Council" and that "the Federated Society is so completely nebulous that one cannot commend or condemn it" are refuted in definite terms. The new organization will compete with none of the existing societies nor appropriate any of their functions; it has already come into existence and the unanimous expression of those attending the conference at Washington is sufficient to assure the success of the project. Its purpose is clearly expressed in the constitution: "The object of this organization shall be to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern to the engineering and allied technical professions."

Pike's Peak and Cripple Creek

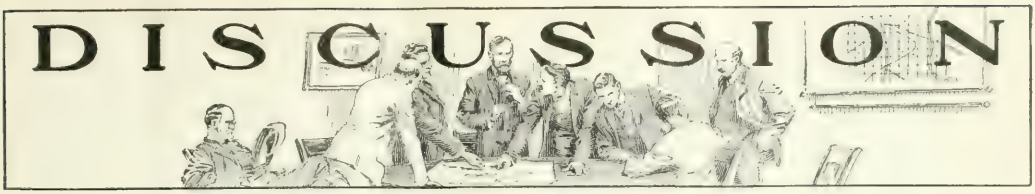
On July 14 the centenary of the first ascent of Pike's Peak was celebrated at Colorado Springs. The event provokes a retrospect. The soldier explorer, Lieutenant Zebulon M. Pike, who discovered and named the mountain, was not the first to ascend it, that honor being claimed by Dr. Frank James, a member of an expedition under Major Long, who has likewise given his name to one of those hoary sentinels that look down upon the prairie around Denver. Dr. James ascended Pike's Peak on July 14, 1820, starting from Fountain creek, *la fontaine qui bouille,* the spring that bubbles, as it was called by the French trappers long before Manitou Springs came into existence. In honor of the first ascent, Major Long named the mountain James Peak, but as the earlier trappers and plainsmen had called it Pike's Peak as far back as 1810, this name survived, and Dr. James conferred his name upon a peak to the north, not far from that which was named after his chief, overlooking Boulder and Estes Park. Since then a bridle-path, a wagon-road, a railroad, and an automobile road have been built successively to the summit for the benefit of the thousands of tourists that go thither every year. A caterpillar tractor reached the summit last year and shortly thereafter an aeroplane sailed over the mountain, so that all the fascination of aloofness and loftiness has been taken from poor old Pike's Peak, but the essential romance remains. In the early years of the last century the snowy crest of this granitic *massif* served as a beacon to the *voyageurs* and explorers who preceded the advance of civilization westward; in 1849 a party of Georgians, led by the Russell brothers, camped on Cherry creek, near the present site of Denver, on their way to Downieville, California. In 1858 some of the members of this party returned to Colorado and uncovered the gold veins of Clear Creek and Gilpin counties. In 1857 a financial panic had broken the moorings of thousands of enterprising spirits and had incited a wave of popular migration westward across the prairies until it broke against the ramparts of the Rocky Mountains. In their progress across the plains the leaders riding in front of the wagon-trains would seek with shaded eye for the first glimpse of the beacon mountain whose white crest on the far horizon gave promise of the land of gold. 'Pike's Peak or Bust', the motto of the adventurers of 1857 and 1858, sounds but mock-heroic in our ears, yet it expresses something of the mingled humor and daring of the men who pierced the unknown wilderness which was then the borderland of the Territory of Kansas. Thus the immigration that marked the birth of Colorado's mining industry was called "the Pike's Peak excitement"; but it expressed a delusion. No noteworthy discoveries of gold were made at that time in the canyons or on the hills surrounding the peak. Important finds of gold and silver ore were made about 70 miles northward, under the protecting shadows of Long and James peaks. Although mines were started in many parts of Colorado during the succeeding twenty years, the silence of the Pike's Peak region remained unbroken. The cattle grazed on the sunny western slopes while towns and railways were being built amid the foothills of the eastern approach, but the prospector found nothing to justify the tradition of gold in the granitic battlements that rose above the line where the pines ceased to climb into the snowfields. Suddenly, in the spring of 1884, rumors came of a great discovery of gold ore on the southern side of Pike's Peak. During the darkness of an April night a horde of prospectors stole swiftly away in obedience to the vague hints that had been scattered among the saloons of Leadville and the neighboring mining camps. Each party aimed to be first on the ground. The dawn of the next day found an excited crowd of four thousand men gathering at the foot of a pine-clad slope. This became known as the Mt. Pisgah fiasco. Among the hills, which like a flock of sheep cluster at the southern base of Pike's Peak, there is a dark cone standing in solitude above its smaller brethren. This is Mt. Pisgah. In 1884 the miners who rushed thither could find no gold save in the prospect-holes made by the first locators. Salting was suspected, the man who had instigated the rush had decamped, an accomplice was caught with a bottle of yellow stuff in his

pocket. It was not whisky, but its quondam antidote, the chloride of gold. Angry feelings found vent in threats of lynching, but in the failure to lay hands on the real perpetrator of the fraud, the affair was turned into a big picnic and a general drunk. A little digging had been done, one or two veins had been uncovered, but the poverty of the ore only added bitterness to the general disappointment. The prospectors disappeared as quickly as they had come. The hillsides resumed the quiet aspect of the cattle range for which they seemed best fitted. Pike's Peak was no mining district; it was left to the cows and the tourists. Nevertheless within ten years Mt. Pisgah overlooked the very streets of the town of Cripple Creek with its 20,000 inhabitants, and on the surrounding ridges the smoking shaft-houses bespoke a long series of rich mines. The lodes of Cripple Creek were discovered in 1891, seven years after the Mt. Pisgah fiasco. During the interval prospectors had wandered over the hills from Colorado Springs and Florissant; indeed, it is said that a shallow shaft, dug by the pioneers even before 1884, was found just above the site of the Victor mine, which was one of the first to rise into importance during the early 'nineties. Some of the cowboys employed by the cattle-men did a little desultory prospecting after the rains, when float is easy to detect. Among these was Robert Womack, who discovered the vein, in Poverty gulch, on which the Gold King mine was based. That was in 1888 or thereabouts; in February 1891 he showed his find to E. M. de la Vergne and F. F. Frisbee, of Colorado Springs, both experienced miners. Then came Stratton's discovery of the Independence on July 4, 1891. That event marked the birth of Cripple Creek, which two years later, in 1893, attracted thousands of miners thrown out of work by the collapse of the silver market. In 1891 Cripple Creek produced $2060; in 1898, $13,507,349; in 1900, $18,147,081. The tradition of Pike's Peak was fulfilled.

Mr. Harding's Acceptance

A man may own a newspaper and yet not know how to write. If Senator Harding's speech of acceptance had been sent by an unknown man to any self-respecting editor, he would have known what to do with it, without hesitation. We know of no better example of an effort to be magniloquent and to fail utterly, of an attempt to use a style wholly unnatural to any sensible man, of a method so affected as to be utterly ludicrous. The gentleman now at the White House must have chortled when he read the effusion of his intended successor. The President wallows in words himself occasionally, but he has enough of literary skill not to permit himself to be bogged in verbiage, as the Senator from Ohio does repeatedly in his recent utterance. The straining at effect is marked not only by repeated use of the abstract instead of the concrete, but also by the introduction of strange words for which even the sanction of the dictionary is lacking. We select one or two of the Senator's purple patches:

"We must stabilize and strive for normalcy, else the inevitable reaction will bring in its train of sufferings, disappointments, and reversals." He means we must strive to restore normal conditions. "When the compact was being written, I do not know whether Europe asked or ambition insistently bestowed." The reference is to the President; he means the ambitious man at Washington. "Ours is an outstanding influential example to the world, whether we cloak it in spoken modesty or magnify it in exaltation." This is worthy of the baboo who announced his mother's death by stating: "The hand that rocked the cradle has kicked the bucket". "Speaking our sympathies, uttering the concurrence of all the people, mindful of our right to dwell amid the good fortunes of rational, conscience-impelled advancement, we hold the majesty of righteous government, with liberty under the law, to be our avoidance of chaos." Presumably the man in the street will think this is high-brow stuff and excuse himself thereby for his inability to understand it; any educated man will recognize it to be piffle, hardly worthy of a high-school sophomore. Apart from the ridiculous phraseology of the speech, we note the most naive evasion of any clear expression of purpose. For example, we are told: "We must not abridge the freedom of speech, the freedom of the press, or the freedom of assembly, because there is no promise in repression", but, "We do hold to the right to crush sedition, to stifle a menacing contempt for law, to stamp out a peril to the safety of the republic, etc." Is it fair to ask how sedition and anarchy are to be checked if freedom to speak, to write, and to assemble are not to be limited by reasonable regulations? Again, as to Mexico, we are told: "It will be simple to have a plain and neighborly understanding; merely an understanding about respecting our borders, about protecting the lives and possessions of American citizens lawfully within the Mexican dominions." Simple, is it? It is the crux of a difficulty that has baffled the best intelligence of two Presidents, Mr. Wilson and Mr. Taft. Simple, indeed? it is the essence of our trouble with Mexico and it is the kernel of our foreign policy. Mr. Harding dismisses the greatest problems with the wave of a rhetorical hand; thus, speaking of economic unrest, he says: "I decline to recognize any conflict of interest among the participants in industry". The interests of the capitalist and the laborer are identical, he proceeds to explain. This is nonsense; can he exorcize the evil spirit or the more substantial facts that menace our industrial progress merely by "declining to recognize" them? Is it only a theory, not a condition, that confronts us? We have criticized frankly, for criticism should be brought to bear upon the utterances of men to whom great power is proposed to be given. It remains to recognize the modesty and sincerity of Mr. Harding's concluding remarks, in which he drops his false diction and talks like an honest man. It is a pity that the spirit of his peroration was not permitted to suffuse his entire speech. We await Governor Cox's speech of acceptance with increasing interest.



Recent Metallurgy at Trail, B. C.

The Editor:

Sir—In reply to the letter from P. R. Hines appearing in your issue of July 10, I beg to say that at the time of my visit to Trail it was impressed upon me that both the concentrating plants treating the Sullivan ore, although yielding a satisfactory concentrate, were still in the experimental stage and, for that reason, no exact details of either feed or concentrate could be given; so I contented myself with general principles rather than detailed descriptions of the machinery employed in both plants. In the original draft of my article I went more deeply into details, but when I found I was unable to give the working results, I thought it inconsistent, and so deleted it.

As Mr. Hines states, two poles of a magnet cross the main belt of the Dings magnetic separator and each has a narrow cross-belt, but, as a matter of fact, when I saw the machine in operation the first pole that the pulp crossed was removing practically all the magnetic particles, leaving little or none for the second pole to pick up, and, for that reason, I did not mention the existence of the second pole. The general arrangements of the plant were substantially the same as when Mr. Hines saw it.

The wet magnetic and flotation plants were being run against each other with a view to discovering which is the better process for dressing the Sullivan ore. Recently, I understand, the magnetic plant has been dismantled, so, presumably, the flotation plant has been awarded the palm. This does not mean, of course, that flotation necessarily would be better than magnetic separation for the removal of pyrrhotite from other ores, as without doubt, the wet magnetic machine is capable of extremely good work.

It must be remembered, however, in this connection that the Sullivan ore is an exceedingly complex one, carrying pyrite as well as pyrrhotite, both of which, of course, it is desirable to remove as completely as possible. Added to this, according to the superintendent of the plant, prior to the heat treatment the pyrrhotite is only feebly magnetic. Whether the so-called pyrrhotite is really all pyrrhotite I am inclined to consider doubtful. A careful microscopic analysis of polished surfaces of the ore may reveal other minerals closely associated with the pyrrhotite that at present are not known to exist in the Sullivan ore.

F. H. Mason.

Victoria, B. C., July 16.

Wages, Profits, and Social Ethics

The Editor:

Sir—As stated in an editorial in a recent issue of your paper the present demand of the organized workers on our railways for a minimum annual wage of $2500 offers not only a serious problem for sociologists but for everyone interested in the continued success of democratic institutions. As late as 1916 the average annual railway wage was under $700, it is now over $1400, but as the minimum wage is considerably less than the average in both cases the new demand means at least a doubling of the existing scale and a quadrupling of the rates of 1916. Is there any limit to wage demands or to the possibility of meeting them?

In the simple days of production by hand-labor, which prevailed everywhere till the later 18th century, this question was easy to answer, for it was self-evident that no worker could hope for a greater wage than the value of his own output. If one cobbler could make two pairs of shoes daily while his mate made but one, even an apprentice might calculate that while the first deserved just twice the wages of the other, even the first could not hope for a day's pay larger than the selling price of two pairs of shoes less the cost of the material to make them. But in a modern shoe-factory, organized to realize on the economy of machine-production by a minute division of labor, the problem of apportioning to each worker his rightful share of the total output is far from simple; to solve it requires both a practical knowledge of shoe-making and an intimate acquaintance with political economy and social ethics.

Modern industry is nominally conducted on the competitive system. The price of commodities is fixed by competition between the various producers in the marketplace, the price of labor is set by the competition between several workmen for the same job. Similarly, the interest on capital is fixed by competition between its owners for the notes of an entrepreneur. In the many industries where this basis, of a fair field and no favor for all competitors, actually prevails, the problem of an equitable division of the annual gain between masters and men is greatly simplified. If the owners be allowed the competitive rate of interest on their capital, and the men be granted the competitive rate of wages for each class of work they do, it is clear that any surplus remaining, after making proper allowances for the insurances, depreciation, and amortization of the capital, can easily be divided between masters and men on some mutually satisfactory basis wherever both sides are sufficiently intelligent and

fair-minded. That such is the case has been proved by many profit-sharing experiments in both Europe and America. Two of the most successful recent examples of such practice have recently been described: the first is a large cotton-print factory at Wappinger Falls, N. Y.,[1] the second is the Hydraulic Pressed Steel Co. of Cleveland, Ohio.[2]

Unfortunately for industrial peace and the attainment of an ideal society, the profits of many enterprises are not limited strictly by free competition, notwithstanding the opinion to the contrary of many superficial economists. Therefore the Cleveland factory's policy of 'telling the truth' and sharing the profits has only a limited range as a social panacea, for it is clear that the mere sharing of unearned profits with the workmen will not right the wrongs of those mulcted by such an enterprise. Moreover, the less the profits are earned by industrial efficiency, the less will the owners have need for the enthusiastic co-operation of their employees, and the less liable will the former be to make the latter the sharers of their financial secrets.

It is the prevalence of this anachronism—vast quantities of unearned profits in a supposedly competitive society—that has made the militant labor-unions useful and even essential for gaining for the workers some share in the new wealth due to improved methods of production. In spite of considerable success in raising the nominal rate of wages for their followers, few labor leaders understand political economy, and they therefore are liable to make impossible demands on employers, or else to gain an increase of wages at the expense of an increase of commodity prices, and thus perhaps injure the workers more in their consuming capacity than they benefit them as wage-earners. For scrutinizing the possibility of raising wages by union effort, all industries must be divided into six classes: I, universally competitive; II, nationally competitive; III, locally competitive; IV, legally monopolistic with competitive prices; V, legally monopolistic with monopolistic prices; and, VI, artificially monopolistic.

Class I. Universal competition may be illustrated by cotton-cloth manufacture, in any free-trade country like England, where a world-wide competition keeps the difference between the cost and the selling price of the product so small that the employer has little or no surplus, above the necessary cost for his capital and supervision, for the increase of wages. If he raises the selling price for his cloth, he will lose his customers. Unions therefore must increase the daily output of their members if they wish higher wages in this class of industry. As in such an endeavor the financial interests of the employer coincide with those of the men and the community, we have here no natural obstacle to impede either the introduction of industrial democracy or the opening of the books to the general public.

Class II. National competition may be illustrated by woolen-cloth manufacture in any country protecting it from foreign competition by an import duty, like the United States. In this class the possible surplus for raising wages would be the difference between the existing cost of production, and the foreign price plus transportation and import duty; because a combine of all the employers could advance the selling price of their cloth to this latter sum without danger of losing their home market. As soon as our woolen-mills have sufficient capacity to supply the domestic demand, their selling price will be set by competition among themselves and tend to fall below the price of imported cloth. While this status of free competition prevails, our protected manufacturers will have just as much to gain from industrial democracy and no more to fear from their balance-sheets becoming public property than have their counterparts in free-trade England. It is only when they abandon competition and combine, so as to fix their price with reference to the protective tariff-wall that they can acquire an unearned profit, and must needs become autocratic and mysterious, in order to defend themselves from prying labor-leaders on the one hand and from tariff-revising statesmen on the other.

Class III. Local competition is illustrated by the building-trades of a city, where the only limit to an advance in the prices for construction is the danger that contractors and workmen will be brought in from a near-by city to do the work. There is therefore a strong temptation for local contractors to form a combine, so as to advance their prices to this natural limit and thus gain an unearned or monopoly profit. Such a combine, in order better to defend itself from underbidding by 'scab' contractors and hold-up strikes by labor leaders, has found it usually advantageous to establish the closed shop and divide its loot with its union workmen. In some cases, especially in plumbing, the supply-houses are also in the combine and will sell their goods only to its members. Among our big cities, Chicago and San Francisco have been notorious for such building-rings, which have stopped at no means, fair or foul, to maintain their monopoly. As such a ring greatly increases the cost of houses, it means higher rents for everyone, including the workmen, of whom only a small fraction belong to the building-unions and get a compensatory wage. As a contractors' combine shares both its profits and its secrets with its workmen, it may be considered as the application of industrial democracy to predacity, the public being the prey.

Class IV. Legal monopoly with competitive prices is based on the ownership of all classes of land except that of public utilities.[3] In the popular concept, nothing is a monopoly that cannot set the price of its product; but, technically, the exclusive possession of national resources, conferred by a land-title, represent a monopoly irrespective of the land's relation to commodity markets. Economic rent, or the income arising from the land itself apart from its improvements, is unearned by the indi-

[1] 'Industrial Democracy at Wappinger Falls', 'Literary Digest', March 6, 1920, p. 115.

[2] 'Tell the Truth', 'The Outlook', Jan. 28, 1920, p. 148.

[3] 'Mr. Ingalls and Walkerian Economics', by the writer, 'M. & S. P.', Vol. 119, p. 627.

vidual land-owner, for it arises solely from some quality inherent in the valuable land that enables it to yield a residuum after all the necessary costs for the use of labor and capital to render it productive have been paid. While large areas of privately-owned land are so lean as to be rentless, the superior lands yield an income of economic rent, which comprises the bulk of the wealth engendered by a community working as a social unit. Any enterprise of this class, therefore, which owns superior land and employs many workmen—such as numerous mining and lumber companies—is sure to yield a monopoly profit (rent) which will arouse the cupidity of labor leaders if they discover its existence. Any share of this profit that a labor leader can secure for his followers will mean a net increase in wages, since here the profit (rent) is not due to a monopoly price but to the superiority of the productive factor (land) and therefore the cost of commodities is unaffected, be its recipient land-owner or laborer. It is thus to the interest of this class of enterprises, as land-owners, to conceal carefully all details of their capitalization and income from their employees; while as producers their interest may lie in the opposite direction so as to improve their labor efficiency by profit-sharing. The greater the rent in proportion to the total profit, the more will the former policy outweigh the latter in the practice of an enterprise. As rent is an unearned profit authorized by law, the great land-owners are much less vulnerable to militant unionism than are the illegal monopolists of Class VI. In the United States before the Great War, it was only where the rich landed enterprises employed a large proportion of the voting population and this was well organized—as in the Rocky Mountain mining districts—that they were obliged to pay out any considerable share of their rental profit in the form of higher wages.

Class V. Legal monopoly with monopolistic prices includes three sub-classes of property: (*a*) Special lands of limited areas so that the world's price for their product can be fixed by any owner who may have acquired control of the bulk of them, for example, the Diamond Trust of South Africa, the Borax Trust of England, and the Henequen Trust of Yucatan. In countries with a protective tariff it suffices for one owner to acquire control of the domestic lands in order to fix prices independent of national competition, for example, the Aluminum Company of America with its ownership of bauxite deposits. (*b*) Public utilities such as railways, telegraphs, telephones, oil, gas, and electric trunk-lines. Here, owing to the franchises required and the cost of duplication, an enterprise can largely fix its own prices for service at whatever 'the traffic will bear'. This condition prevails except at 'competitive points', where two or more enterprises may offer the public the same service, and in countries where the rates charged by public utilities are strictly controlled by charter of or by a government commission. (*c*) Patents for invention, as granted by the United States, confer a monopoly for the manufacture and sale of the article upon the grantee, and consequently free the latter from competition in fixing his selling price.

From the above, it is evident that the unearned profits of sub-classes (*a*) and (*b*) proceed partly from the legal advantage conferred by the ownership of superior land (mines or rights of way) and partly from the power of charging prices for the output independent of the natural regulator called competition. In sub-class (*c*) the unearned profit proceeds solely from this latter power, for any reasonable royalty paid to the inventor should be regarded as merely a fitting reward for his services to society. The relation of labor to the enterprises of sub-class (*a*) duplicates its relation to those of Class IV in so far as the unearned profit proceeds from superior land; where such profit proceeds from the enterprise's power to fix prices, any share of this obtained by labor will result in a higher price for the output to the consumer whenever the increase will mean more of an annual income for the owner. The last statement likewise holds true in the case of enterprises of sub-class (*c*) owning patent rights; so, in both cases, the gain of the monopolist's workmen may mean a loss for the consumers. The public utilities of sub-class (*b*) resemble sub-class (*a*) in their relation to labor, and have a relation to the public similar in kind but widely different in degree. On American railways a general increase of wages during the Great War has meant the ruin of thousands of investors in their securities, while should the investors be compensated by a corresponding increase of rates for service, the public must meet the expense in the form of dearer commodities.

Class VI. While artificial monopolies for the purpose of suppressing competition may be formed among enterprises of Class II or III, as already described; the largest and most profitable ones, like the Standard Oil, the Beef Trust, and the United Shoe Machinery Co., have owed their power chiefly to the ownership or control of monopolies of Class V, by which they gain advantages not enjoyed by their rivals. A recent demonstration of this fact is afforded by the surprising number of independent oil-refineries that have sprung up in the United States since the pipe-lines of the Standard Oil group were declared to be common carriers a few years ago.

In normal times, artificial monopolies of a temporary nature have been features of the commodity exchanges. These 'corners' of the market have also depended for success upon secret alliances with the legal monopolies of Class V, through which they enjoy special favors, usually in transportation. In wheat, the *coups* are commonly made by speculators controlling a string of elevators closely identified with some railway system.

Since 1914 the dislocation of production, caused by the Great War, has rendered it easy to corner many commodities that formely were too plentiful to permit of such an operation. This game has become so simple and profitable that few merchants can resist the temptation to take a hand, so we have coined a new word, 'profiteering', to describe it. The hue and cry due to this merciless mulcting of the consumers has driven the politicians nearly frantic, and the profiteers are being combatted by remedies as wide apart as jail sentences and overall clubs.

In so far as the unearned profits of the enterprises of Class VI are concerned, they accrue regardless of efficiency in labor and there is therefore nothing to be gained directly by the introduction of profit-sharing to balance its cost to the owners, but operating as the latter do in defiance of both the Common Law against combinations and the Federal statute against restraint of trade—Sherman Anti-Trust law—many of them realize their political weakness and have been wise enough to pay their workmen the best of going wages, so as to avoid strikes and their frequent accompaniment of dangerous investigations of business secrets by meddling politicians.

The above remarks have proved, I hope, that labor-unions may often increase their members' wages without augmenting either their production or the cost of living. A successful attack on unearned profits by militant unionism will never increase living costs where the profiteers belong to Class IV and seldom do so when they belong to Classes V or VI. Nevertheless, these battles between masters and men cause vast inconvenience to the public and much needless suffering to innocent bystanders, however closely they may observe the laws against physical violence. Whichever side succeeds in gobbling the lion's share of the unearned profits, which form the bone of contention, the practical question is: Has the struggle been unavoidable and the ensuing result ethical? It is just here that we have a use for social ethics brought up to date—for in this subject there are few teachers whose knowledge of industrial relations is of a later period than the early 18th century or who possess a sufficient mastery of political economy to analyze correctly such relations as they may now encounter.

The Industrial Court recently established by the State of Kansas proposes to protect the public from further labor wars by taking over for State operation any essential industry whose owners or employees refuse to obey the Court's rulings and suspend work. The Court has power to alter any labor contract. Picketing and blacklisting are equally outlawed, while striking or calling a strike are made punishable by heavy fines and imprisonment. A student of history can feel no great certainty for the success of this Court. Lacking any intelligent code of social ethics on which to base its decisions, its chief effect will be a partial transfer of the labor war from the industrial to the political field. Each contestant will strive to name its own partisans as judges, so that labor will be oppressed or capital mulcted according to whether capital or labor chooses the State's governor who makes the appointments.

While private monopoly has been execrated by American politicians for half a century and multitudinous laws have been framed to suppress it, little has been accomplished even to restrain its operations except in the case of certain price-fixing monopolies—the public utilities—of Class VI. But as the land-value or monopoly element of all public utilities comprises scarcely 25% of the total land-values of the country, the campaign against monopoly can scarcely be considered a brillian success, even without considering the many artificial monopolies of Class VI that still continue to flourish. Indeed, no marked change can be expected until the public ceases to regard money as the badge of distinction and becomes familiar with the simple economic laws that govern the distribution of wealth.

If a monopolist does not earn his profits in the fair field of a competitive market, it is clear that his profits proceed from the earnings of somebody else and are therefore stealings, however much the fact may be camouflaged by property laws inherited from the conditions of a bygone age. Similarly, a militant unionist is a thief when he forces his employer to pay him as wages several times the value of his contribution in labor to wealth production; for such an excess wage must mean either the mulcting of the consumer, by high prices, or the private absorption of economic rent—the rightful heritage of the nation under our existing political system, if justice were done.[4] So it is hardly consistent for the bourgeois to applaud an investor for drawing out $1000 from a $10 investment, and condemn a proletarian who demands $10 for $2 worth of labor.

Anyone who has resided in a medieval country like Mexico must realize how far modern America has advanced beyond the ethical code of the 16th century. Nevertheless, our code is still notably archaic in its lack of provision for an equitable distribution of wealth in a political democracy working under the factory system. This defect—hitherto marked by fortuitous conditions[5]—is becoming glaringly evident as an aftermath of the social dislocation resulting from the Great War and must be remedied if American ideals of freedom of opportunity are to be preserved. The remedy can be readily prescribed from the proved principles of political economy, but at present our practical politicians have no knowledge of, nor use for, this science and its adepts.

ROBERT B. BRINSMADE.

Ixmiquilpan, Mexico, July 11.

ONLY a large deposit of mica, favorably situated with regard to transportation and a grinding-mill, can be worked solely as a source of scrap-mica for grinding. Most mica mines must also yield good sheet-mica to make the mining profitable. Mica to be of value as sheet must yield rectangles at least 1½ by 2 in. that must split easily and evenly, be free from cracks, markings, and fracture lines, and be reasonably free from specks or foreign mineral matter. The size stated is the smallest rectangular size which is salable as uncut sheet, and the rough-trimmed mica sheet must be nearly twice as large to yield the rectangle stated. In order to be profitable most deposits must also contain some mica larger than 1½ by 2 in., according to the U. S. Geological Survey. Good sheet-mica should be so flexible that a sheet one-thousandth of an inch thick can readily be bent into a cylinder one-quarter of an inch in diameter without showing any crack.

[4] 'Story of my Dictatorship', by L. H. Berens, Chap. XV.

[5] 'Free America', by Bolton Hall, Chap. I.

A History of Mine-Fires in the South-West—Part I

By CHARLES A. MITKE

Introduction. The problems that primarily confront the manager of a mine are those of ore-reserves, methods of stoping, transportation, equipment, supplies of labor and materials. While these absorb practically the entire attention of the staff, they fail to include the possibility of a fire underground, which may destroy valuable property in a short time and result in a complete shut-down of the mine for an indefinite period. Drifts and stopes may be caved in a few hours by the burning of timbers, shafts may be destroyed and manways ruined, to say nothing of the loss of lives or the number of men invalided by breathing poisonous gases in the process of fighting fire.

The erection of a large building is never undertaken without preparing careful plans for protection against fire and providing a full equipment of fire-fighting apparatus. In addition to this, the owner carries heavy insurance to reimburse him in the event that all his prearranged plans for preventing or fighting the fire fail at the critical moment. In the mining industry, however, there are mines of an estimated value of from $100,000 to $50,000,000 that lack an adequate system of fire-protection, that have little or no equipment available in case a fire breaks out, and, of course, no fire insurance underground, for as yet no insurance company has entered this field. Should an outbreak occur, there is not only the danger of destroying timber, which often results in extensive caving, but frequently stopes must be sealed, thus preventing the mining of large bodies of ore for years. It is a well known fact that some of the big copper mines of this country contain large bodies of pay-ore which have been sealed for many years, and there are a few instances where even high-grade ore has been locked up and lost temporarily on account of dormant fires.

The principal reason for sealing mine-fires is to localize them and so permit the rest of the mine to be operated in safety. This practice was followed wherever possible in the past, and has proved especially successful in orebodies stoped by the square-set method. Under such conditions, the filling of stopes with waste at intervals, as the ore is removed, usually prevents the ground from caving to surface. In the top-slice system, however, the conditions are entirely different. With few exceptions, it is impossible to seal hermetically a stope that has been worked by top-slicing, as, this being a caving method, the overburden generally breaks to surface and allows the air to find its way down to the fire, while the heated gases work their way upward through the mat of timber. In a few exceptional cases, where the overburden of the top-slice has not broken to surface, a seal may be effective. This, however, presents a dangerous condition, as large blocks of ground from the arched overburden may drop at any time and crush the top-slice, closing all drifts and manways.

It is the general impression that a fire cannot occur in a stope operated by the shrinkage system, as this method of mining requires very little timber. There are cases on record, however, where the cribbings in shrinkage stopes have taken fire, the flames following the timbered raises to the haulage-levels and ultimately causing the caving of both the stope and the haulage-level.

While it may be possible to abandon and seal that part of the orebody that is on fire in mines containing large bodies of low-grade ore, the management of high-grade properties cannot afford to follow this method of procedure, as the ore usually occurs in a very limited quantity, and it is absolutely necessary to work out some means of handling the fire in order to continue operations without curtailing production.

The following is a brief account of some of the fires that have occurred during recent years:

Bisbee-Warren District

One of the most serious fires in this district was that in the Lowell mine of the Copper Queen branch of the Phelps Dodge Corporation, which started in January 1911, and is sealed up at the present time. The place where the fire originated is between the 1000-ft. and 1200-ft. levels, and was mined by the square-set system. The orebody contained a high percentage of sulphur and undoubtedly some pyrite had been lost in the waste. While it has been the general practice in the South-West for a number of years never to put any pyrite in the filling of stopes, nevertheless, with the most careful mining, there are times in handling fine material when it is impracticable to prevent a few tons of pyrite from escaping into the waste. Even with excellent supervision, a careless miner may allow this small amount to run into the fill unnoticed. This small amount of pyrite, coming in contact with timbers, under pressure, is sufficient to produce the heat required to start a fire.

At the Lowell, the progress of stoping naturally caused considerable friction between the blocks of sulphides, which created a great deal of heat. Oxidation of pyrite and timber was also an important factor. The temperature increased until the timbers took fire, and they in turn started a fire in the sulphide ore. The resulting gases, such as SO_2 and the distillation products of wood, came to the upcast shaft and caused considerable damage by corroding the heads of lag-screws in the guides, with the consequence that some of the guides fell out and jammed one of the cages near the 600-ft. level, which put it out of commission, while the other cage was in danger of meeting the same fate at almost any time.

In 1911, at the time this fire started, the Lowell mine had only one shaft, which, as stated above, was an upcast, the intake air coming from an adjoining division (the Sacramento), and as the fire could not be reached conveniently from below, it was absolutely necessary to make an attack from above. This implied the use of the shaft, and made repair-work essential before fire-fighting could be organized. It was therefore decided to start with the free cage and commence repairing the shaft from surface to the 800-ft. level, the place where the gases first entered the shaft.

On account of the large amount of carbon di-oxide and sulphur di-oxide, the men were compelled to use oxygen helmets while carrying on the repair-work, which consisted of putting in 500 lag-screws; taking out an old electric cable, which had worked its way across the shaft and was beneath the free cage; chopping out the cage, which, owing to the falling out of the guides, had jammed hard against the timbers; and putting in 150 ft. of new guides—quite a dangerous and extensive piece of work to be accomplished by men wearing oxygen helmets.

Owing to the unusual circumstances, the men, while on duty eight hours, were only asked to perform actual service for two hours of the day. On account of the heat and gas, the time of the helmet-crew was originally divided as follows: 20 minutes of actual work in the shaft, and from 40 to 50 minutes resting and overhauling the apparatus. Great difficulty was faced by the men using the breathing-apparatus in the hot and gaseous atmosphere, as the sulphur di-oxide, in combination with excessive natural perspiration, formed sulphurous acid, and in a comparatively short time the men had large burns all over their bodies. Finally, the total working-time of two hours per day in actual work had to be cut down to an hour and a half, and some of the men had to remain idle in order to recover from their burns.

On a few occasions, while two men were n the cage between the 400-ft. and 600-ft. levels, the breathing-apparatus of one of them gave out, making it immediately necessary for the other to pull the signals and bring his companion to surface. In several cases, the men brought to surface in this condition were partly unconscious when the apparatus was removed, so that artificial respiration had to be performed.

After the shaft was repaired and the cages again in operation, so that supplies could be taken to the different levels, it was not long before the fire was successfully sealed. As this ore is not needed for present production and its recovery would involve a large expenditure, the fire-area will not be re-opened for some time to come.

On December 2, 1915, fire again broke out in a stope adjacent to the one described above. As the men had just gone on shift, the bosses were instructed to bring the entire force back to the different shaft-stations immediately. The fire spread rapidly and the smoke and gas penetrated nearly all the workings between the 900-ft. and 1300-ft. levels during the first day. Part of the gas escaped through the Oliver and Cole mines of the Calumet & Arizona Mining Co., where six men were overcome.

At the time of the first fire in this mine (Lowell) there was but one outlet to surface, namely, the shaft that had to be repaired (the intake being from an adjoining mine, the Sacramento). It was impracticable therefore to use mechanical ventilation, and all repairs and fire-fighting had necessarily to be done by helmet-men. After this first fire was sealed, and prior to the new outbreak, a raise had been put to surface for the purpose of having a permanent outlet for smoke and gas, and a system of mechanical ventilation had also been established. When, therefore, the fire broke out a second time, the general mechanical ventilating system was kept in continuous operation, and an auxiliary system quickly was introduced to take care of the fire-stope. Aside from 10-in. blowers and ventilating-pipe, a 3-ft. disc-fan was used, which furnished a large volume of air at a low pressure. This created a better atmosphere and permitted the larger part of the work of fire-fighting to be done without the use of oxygen apparatus.

Within two and a half days, the fire was sealed, and no further outbreaks have occurred.

In each case, after the fires were sealed, water was turned in through the bulkheads; this finally collected in a drift on the 1300-ft. level, known as 'Copper River'. A small precipitating-plant on this level has yielded handsome returns.

Other important outbreaks, as regards size and danger to life and property, were the several fires in the Holbrook mine, of the same company.

In the early part of 1912, a district in this mine, between the 200-ft. and 400-ft. levels, known as the 'Neptune', became exceedingly hot, but the volume of smoke and gas was small. Toward the end of the year, however, an outbreak occurred and the fire-area was sealed without delay.

On July 13, 1913, another fire broke out in the Holbrook. This was located in a square-set stope between the 500-ft. and 600-ft. levels. At that time the mine was ventilated by natural means. The smoke and gas proceeded along the 600-ft. level to the Spray, Lowell, and Sacramento, and caused an immediate shut-down of these three mines. During the first hour, while in search of the origin of the fire, the assistant-superintendent and one of the shift-bosses were overcome with gas, while the mine-superintendent became delirious. These men were rescued with great difficulty. Owing to the foreman's presence of mind, the pulmotor and oxygen apparatus had been sent previously to the mine, and as the men were brought out through the raise from the 500-ft. level, the pulmotor was immediately applied until they recovered sufficiently to be sent to the hospital. Exploratory work was continued until the fire was reached. A plan was then formulated to seal all the drifts and raises leading from the fire-stope. Temporary brattices served to check the gas, so the men could work without using the oxygen apparatus. Finally, cement bulkheads were built. Two churn-drill holes were put down from the surface, immediately over the fire-stope, and water turned into them. After several months, the fire-area was opened

and it was found possible to extinguish the smoldering remnant from the 500-ft. level.

On October 29, 1915, the third Holbrook fire occurred. Smoke was detected coming out of an old stack near the site of the former change-room. This stack had been erected some years before to ventilate an earlier fire-area. The cause of the new fire was the heat generated by the

FIG. 1. THE LOWELL SHAFT OF THE COPPER QUEEN MINE

sealed fire-area; this had penetrated through waste until it reached a raise between the 200-ft. and 300-ft. levels, where smoke and gas burst out, filling the raise and finding their way to surface through the stack. Prior to this outbreak, a mechanical system had been installed to ventilate the lower levels, the natural air currents being depended upon to ventilate the upper workings. After arranging the ventilation so that no smoke or gas would be forced down to the lower levels, water was turned into the raise to put out the fire, then pipes were driven from the raise into the surrounding waste, and connected to water-lines in order to cool all the ground in the immediate vicinity. Midway between the 200-ft. and 300-ft. levels intermediate drifts were started from this raise into the hottest part of the old fills. These were flooded from time to time until the entire area finally was leached. The coppery water from this fire-area, as well as that from other areas in the Uncle Sam and Czar divisions, is pumped to surface, and flumed to the leaching-plant, where the copper is recovered.

On April 29, 1914, gas was noticed on the 1000-ft. level of the Gardner division of the Copper Queen mine, at 150 ft. from the Gardner shaft. The following day three men were overcome while attempting to put up brattices, in order to turn the gas to other outlets, but they recovered when taken into fresh air. Most of the ore had been stoped from this area by the square-set method about ten years before, and at that time some pyrite and old timber had probably found its way into the fill. In the course of time the whole area became hot and the temperature increased until timber-gases were given off. This part of the mine was quickly sealed and some water admitted from above, which apparently had the effect of cooling the ground, for the gas decreased. However, on April 29, 1915 (just a year later), the gas began coming out on the 800-ft. level, immediately over the old fire-area, and it was then found necessary to outline a campaign for lowering the temperature of the entire block of ground, in order to eliminate the dangers arising from continual outbreaks of gas.

A main drift was driven over the heated zone on the 800-ft. level and cross-cuts branching from it at right angles every 25 ft. The faces were so hot that they had to be sprayed thoroughly before the men could commence work. Auxiliary systems of ventilation also had to be used. The work was continued over a period of a year and a half, during which

FIG. 2. TWO MEMBERS OF THE HELMET-CREW ABOUT TO ENTER THE CAGE AT THE LOWELL MINE

time there was a great reduction in the temperature, and the fire-area has now cooled to such a degree that no gas is given off and there is no immediate danger of further outbreak.

In February 1919 a complete shut-down was caused at the Shattuck-Arizona mine by an underground fire

between the 700-ft. and 800-ft. levels in the mine, in the abandoned and filled portion of the low-grade sulphide orebody. Gas and dense sulphur smoke penetrated the workings above the 800-ft. level, making operations unsafe. A force of 50 men was trained in the use of oxygen-helmets. Bulkheads were built to confine the burning area, and preparations were made to flood the workings below the 700-ft. level. To accomplish this, it was necessary to pump into the mine more than 25 million gallons of water. Wood and sulphur gases ceased to escape when the water-level reached a point eight feet below the 700-ft. level. Unwatering of the flooded part of the mine began in September 1919, and mining of copper ore was resumed on a small scale in that month. The workings are now free of water and a force of men is engaged in re-timbering the caved portions of the 800 and 900-ft. levels.*

On the night of March 27, 1920, a fire started on the 1300-ft. level of the Briggs mine of the Calumet & Arizona Mining Co. A large body of pyrite containing masses of copper-sulphide ore had been stoped by the square-set method for a number of years. Owing to the large amount of sulphur in the ore, it was recognized that this was a dangerous area, which sooner or later might take fire. In order to prevent this, a system of ventilation was devised to force large volumes of cool air through the prospective fire-area. This system was established four years ago, and had the effect of cooling the area considerably. Arrangements were made also for the coursing of smoke and gas from a possible fire through an old abandoned raise and level, and thence to surface. At that time it was obvious that as additional timber was taken down the mine each year, and the stoping operations enlarged, the frictional area between the stoped parts and the pyrite would also increase, as well as the amount of heat generated.

Prior to March 27 the area was fairly cool and no fire was looked for at that time, as the men had been working near the point where the outbreak occurred, and one of the bosses had gone through only an hour before. However, the gases that are the result of distillation products from timber were noticed. Simultaneously with the characteristic odor, there was a general movement of ground over old filled stopes, which caused a great deal of friction between the old waste and the edges of the pyritic ore adjacent to the old fills This, in turn, caused much heat so that the timbers of the drifts on the 1300-ft. level ignited simultaneously and soon developed into a terrific fire. Thanks to the co-operative effort of the mine organization, excellent work was performed in extinguishing the fire in less than 24 hours. After the fire had been extinguished, a small amount of sulphide ore, under a mass of caved material, was still burning. Within a few days this was also extinguished by the application of air and water. The mine was idle only two days, and the operating department deserves a great deal of credit, as conditions were such that this might easily have developed into one of the largest fires that have yet occurred in the South-West and might have caused enormous loss to the company. However, through the foresight of the management in establishing a complete ventilating system to meet just such an emergency, a catastrophe was averted.

A second outbreak occurred on May 2, 1920, but this was not nearly as serious as the former fire and was soon under control. In order to cope with the danger, further precautionary measures are being taken by sinking a new shaft from surface to the 770-ft. level, so as to have a direct outlet to surface from the sulphide orebody. Additional fans will also be installed so that higher air-pressures can be built up to force still larger volumes of air through the hot area.

During the last five years there were two shaft-fires in the Bisbee-Warren district, a small one at the Briggs mine of the Calumet & Arizona Mining Co., which was extinguished in a few minutes, and the other in the White Tail Deer shaft of the Copper Queen. The latter shaft was entirely destroyed to the 150-ft. level, as well as the head-frame and surface buildings, the flames rising as high as 50 ft. above the collar of the shaft. Although this shaft was down to the 300-ft. level, there were no workings below the 150-ft. station, and even though the fire had a good start, nevertheless, on account of lack of air, it extinguished itself at the first level.

Prior to 1911, a large fire broke out near the side-lines of the Irish Mag mine of the Calumet & Arizona and the Spray mine of the Copper Queen, by which more than 30 men were overcome with gas. Fortunately, there were no fatalities in getting the fire under control. A dormant fire exists in the Irish Mag mine, adjoining the side-lines of the Gardner mine of the Copper Queen, near the fire just mentioned. Fire-areas also exist in other parts of the Bisbee-Warren district, but these are well under control and are unlikely to give any immediate trouble.

Cananea, Mexico

During July 1914, owing to political and labor troubles, the mines at Cananea were closed down. On the 23rd of that month, fire broke out in at least nine different places in two of the large mines, the Veta Grande and Oversight. Four of these fires were put out immediately by the foreman and shift-bosses, but the remaining five—two in the Oversight and three in the Veta Grande—were soon beyond control. Several helmet teams from the Copper Queen at Bisbee were sent to Cananea; when the men arrived, the Oversight shaft was afire, and smoke and gas were coming out of the main tunnel to surface, indicating that the fire in the shaft had also set fire to the tunnel. The powder magazine was situated at a point half-way between the entrance to the tunnel and the shaft.

Extinguishment of the fire at first appeared impossible, so the removal of the powder was attempted. As no fans were available, the helmet team blasted the compressed-air line about fifty feet from the tunnel entrance, which resulted in reversing the air currents. Within a few minutes the men were able to work without helmets

*Annual report, Shattuck-Arizona Mining Co.

FIG. 3. PILARES SHAFT OF THE MOCTEZUMA COPPER CO., IN SONORA

mets. The fact that mechanical ventilation was not in use in these mines added to the peril because the gases were liable to go in any direction.

Eventually the fire in the Veta Grande extended to the 300-ft. level and all the haulage-drifts beneath the fire-stopes had to be bulkheaded. Water was admitted from above, wherever possible, until the fire-area had been reduced to a few small stopes. As conditions in Mexico at that time were such that the mines could not be operated, the remaining fire-areas were sealed.

In view of the large number of fires, and also the fact that so many men were employed, who were gaining their first experience in fighting mine-fires, it was extremely fortunate that no lives were lost and no one seriously injured.

in removing the powder from the magazine, and, later, were successful in extinguishing the fire.

All efforts to save the Oversight shaft, however, were unsuccessful, as the fire had gained too great a start before the men arrived on the ground. In a few places the fire spread from the shaft until it entered the timbered mat over some of the top-splice stopes. These had to be bulkheaded and the seal made as effective as possible.

In the Veta Grande, the fire entered square-set workings adjoining the large shrinkage-stopes on the 200-ft. level. This was extremely dangerous, because caving resulted from the shrinkage-stopes as the square-set workings burned out. Practically all the fire-fighting had to be done by men using oxygen hel-

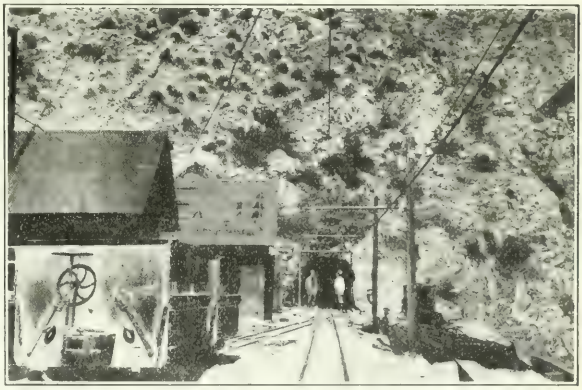


FIG. 4. CLAY ADIT OF THE ARIZONA COPPER CO., AT MORENCI

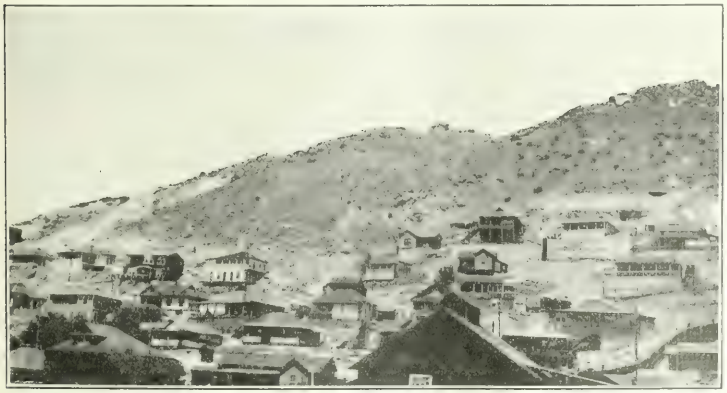


FIG. 5. CAVED GROUND (AT BACK OF THESE HOUSES) OVER TOP-SPLICE STOPE OF THE COPPER MOUNTAIN MINE

NACOZARI, MEXICO

At the Pilares mine of the Moctezuma Copper Co., near Nacozari, two small shaft-fires occurred during the early part of 1918, one on the 800-ft. level of the Gaudelupe shaft and the other on the 500-ft. station of the Pilares shaft. Both these were dis covered immediately and ex-

tinguished promptly. They were caused probably by defective insulation of electric wiring.

Clifton-Morenci-Metcalf District

On September 25, 1916, fire was discovered in the Clay mine of the Arizona Copper Co. at Morenci. This mine was ventilated solely by natural means. Helmet-crews went into the mine as far as the large top-slice stope, known as the Harrison, and found a fire immediately beneath this stope on the adit-level. Preparations were then made to put water on the fire, but the ground surrounding it began to cave, extinguishing the fire in the adit, but not that portion of it which had already passed through the stope and entered the timbered mat above the top slice. It was impossible to reach this, so that the entire mine filled with gas, making bulkheading extremely difficult under conditions of natural ventilation.

A temporary system of mechanical ventilation was then devised, using compressed air, a number of small blowers, a 3-ft. disc-fan, and one larger fan that was hastily built in the company's shops. These fans and compressed-air jets were utilized to clear the workings of smoke and gas, so as to make it possible to reach the Harrison stope, where hose-connections were made in order to force water into the timbered mat. This was a difficult as well as a dangerous operation, on account of the caves that were continually taking place as the bottom of the mat burned out. As the work progressed, it became evident that the visible fire was only the lower extension of a larger one higher in the mat.

By this time another fire had been discovered on the first level of the Clay shaft, adjoining the Harrison stope, which made it necessary to seal the entire fire-area. This required the construction of a number of cement bulkheads on the first, second, and third adit-levels, after which the fire-area remained sealed for some time.

About six months later, some exploratory work was done over the timbered mat above the fire-area, for the purpose of learning whether any of the peaks of flame that had penetrated the mat were still burning, because, in this event, their presence would be indicated by great heat on this upper level. However, through labor difficulties, this work had to be abandoned temporarily.

In November 1917, the above-mentioned level and the entire fire-area were again re-opened under pressure and thoroughly examined. Gas analyses of the atmosphere within the bulkheads showed the presence of a large amount of carbon di-oxide. The fact that mining had only recently been commenced in the top slice and the ground had not yet broken to surface had made it possible to seal the stope. The result was a depletion of the oxygen in the air with a corresponding increase in the amount of carbon di-oxide, which had the effect of extinguishing the fire.

The Harrison stope was then rehabilitated, and later work has shown that there is a complete absence of existing fire, latent heat, or resulting gas.

On October 16, 1916, a fire was detected in a top-slice stope in the Copper Mountain mine of the Morenci branch of the Phelps Dodge Corporation. A large amount of smoke and gas poured from this stope through the Copper Mountain adit. That same evening, and for some time thereafter, a great deal of gas was noticed in the town of Morenci, in the vicinity of the post-office, and some of the residents near the mouth of the Copper Mountain adit had to abandon their homes temporarily. After investigation, it was found that the fire was in the timbered mat, immediately over the stope in question. When efforts failed to extinguish it from below, this plan was abandoned, and bulkheads were built in raises on the 300-ft. level, and water turned in from above, so as to flood the ground and raise the water-level as much as possible. While this was being done, an effort was also made to extinguish the fire from above by driving drifts and cross-cuts over the fire-area. The rock was hard, so that winzes could be sunk from the different cross-cuts and water turned into them at once. As all work in the drifts, cross-cuts, and winzes was carried on in hot ground, blowers had to be used to force large volumes of cool air into the headings. The principal difficulty in fighting this fire was that the ground above was caved to surface, thus allowing some circulation of air. While the active fire was extinguished within a short time, it was several years before the heated ground showed the effects of the application of air and water.

(To be continued)

There is considerable popular misapprehension regarding the occurrence of petroleum. It is sometimes said that oil occurs below the surface of the ground in some regions just as water does in others. This would mean that a well in an oil region is as likely to strike petroleum as a well in a water-bearing region is likely to strike water—that the oil is distributed in an almost continuous sheet beneath extensive parts of the country. This is not true. Another statement frequently heard is that the oil forms an underground 'stream', and that a lucky location for a well must lie over that 'stream'. Expensive and fruitless drilling has repeatedly shown that such 'streams' of oil do not exist. A belief that is strongly held in some parts of the country is that oil pools are connected—that some channel connects the pools in an oil region. This belief is absolutely disproved by the ranks of barren wells that encircle practically every producing oil pool in the world. Another wrong idea is that petroleum occurs in underground ponds or lakes. In fact prospectuses of some oil companies refer to "lakes and rivers of oil", giving the idea of great caverns filled with oil. Not a single such cavern has been found in any oil-fields in the United States. Oil is really contained in the tiny openings between grains of sand, in the pores and crevices of a crystalline limestone, or, as in the largest wells, in the comparatively small openings of a porous rock. The depth at which oil may be found is apparently limited only by the depth to which men can sink a hole. In some fields productive oil-wells are only 100 ft. deep. In others most of the wells are 2000 ft. deep, and many are more than 4000 feet.

Science and Industry

By A. W. ALLEN

Science is knowledge—complete knowledge, knowledge without boundaries, knowledge that brooks no restrictions. It can be made the beacon-light of industry, but not the servant of commercialism. It can be made to point the way to greater and still greater material achievement; but those who would gamble with science as they would with stocks or shares on the Exchange or on the Curb are liable to find an instance where the law of averages does not apply. Luck in a game of chance is just luck. Luck in science—there is no such thing; for with a real search for enlightenment the result is never too great to be unexpected nor too insignificant to be valueless.

No scientist worthy of the name fails to 'make a job' of an investigation—he covers the ground thoroughly. Much of his work appears to the uninitiated to be of no tangible value. Much appears to the superficial observer to lead nowhere. But the scientist knows differently, for he and he alone can gauge the worth of gossamer threads of fact and theory—threads of inspiration that may be woven into chains of evidence leading to great discoveries.

It is the failure to look beneath the surface—the eternal measurement of data and results in dollars and cents—that is leading to a lack of appreciation of the scientific mind. It is commercialism pure and simple that is hindering scientific expansion—a modern commercialism that cannot appreciate the danger in the fact that although science, like virtue (as Kingsley puts it) is its own exceeding great reward, it is liable to die of neglect because of its altruism. What does industry owe to science? What would have been the position of industry today but for science? How much of our present-day comfort and success is due to pure science, how much of our present-day security is due to the work of scientific men? And what could industry have done had it systematically encouraged science during recent years? These are pertinent questions.

Since 1821 the world has been utilizing Michael Faraday's purely scientific discovery in connection with electro-magnetic induction. The primary achievement has been elaborated by experimentation and research to such an extent that it must be admitted that many if not most of the notable electrical inventions would never have resulted but for the science of Faraday. It is to pure science that we owe our major tribute, not to experimentation along commercial lines. For Faraday was prepared to risk so much for pure scientific research that, according to one of his biographers, he gave up the idea of profit because "worldly gains became contemptible in comparison with the rich scientific province he had subdued".

This is the spirit that occasionally gives to the world a great scientist. But what has been done to perpetuate the ideals of Faraday? One wonders how many others, who have the same view of achievement for achievement's sake, are disheartened at the outset by the demands from utilitarianists for a tangible commercial result from all research, and at every stage of the investigation. And must it not be admitted that, so long as the initiative of scientists is cramped and circumscribed by the dictates of those who have no appreciation of the nature of a scientist or the method of his work, no apprehension of the fact that great truths need diligent search, then so long shall we have to remain content with the building of additional stories on the firm foundations already laid, rather than to plan new edifices ourselves.

A common objection to science is that it lacks definiteness of aim. Scientific research may lead nowhere, one is often told. True; but so may also experimental research along predetermined lines. The point that needs emphasis is that, whereas scientific work may lead nowhere, history has shown that it invariably results in achievement, although often arising from a totally different direction from the one originally planned by the scientist. A scientific investigation may have been unfruitful, but the ground has been covered, for once and all, in a scientific manner; and there has been no waste. Hit-or-miss experimentation, so favored by modern seekers after immediate financial results, may be unfruitful as well as useless; for no consideration of any subject is thorough unless it is tackled in a scientific spirit, and with an entire disregard of the ultimate money-value of the discoveries made. And no record of an investigation is worth while unless it is made by an experienced man, one who has all the facts at his finger-tips. In scientific research one thing may be sought, another found. This is an axiom with the independent investigator, whose one aim is revelation, no matter from what direction.

The time is ripe for a realization of the fact that scientific research cannot profitably be hampered by the restrictions that usually hedge the efforts of those who may be employed to solve great industrial problems. A scientist must be given a free hand and trusted to work out his own salvation in his own particular way. The invariable comment is: "But that is no business proposition." No, it certainly is not. Business and science are irreconcilable. A scientist may be a good business-man and he may be a good so-called 'practical' man, but usually he is neither. An intermediary may, and invariably is needed to, translate and deflect the results of his work into utilitarian channels; but this fact does not make purely scientific research the less necessary.

There is a word—'aggressive'—which is used in England to denote the attitude of a person who commits the first act of hostility or offence. American dictionaries

sustain this interpretation; but in American industry today an aggressive manner is a *sine qua non*. The columns of the great dailies are replete with advertisements from self-styled aggressive men who need appointments, and from commercial houses who are on the look-out for employees with the desirable qualification of aggressiveness. In the publication of a large corporation with which I was once connected I read the following warning: "Your advancement is largely in your own hands; it is doubtful whether anyone else is worrying over it." I found that this was literally true; the men who succeeded were those who insisted on a recognition of their qualities. In other words, it is personal aggressiveness that counts. For the individual without it I doubt whether there is any hope of advancement, commensurate with his abilities or efforts, in American industrial or commercial work.

Scientists are not temperamentally aggressive, to use the word in either the American or English sense. Consequently, there will always be a great gulf between industry and science, a gulf that may be bridged but that can never be filled in. A scientist who begins to worry over his prospects of material advancement automatically forfeits the designation. Aggressiveness and science are opposite; and so there is a real danger of the scientist being pushed off the map by the aggressive utilitarian. It is nonsense to point morals from such catch phrases as "the survival of the fittest" or "the elimination of the unnecessary". Industry has taken the funds from the balance which was built up by science; and there is a danger of the account being overdrawn. Science the world needs and must have, but it should not be prostituted to the ideals of undiluted commercialism.

Much of our present-day comfort and so-called civilization is due to the fact that industry has built prosperity on the foundations of disinterested and unpaid effort. Discoveries of great scientists have been utilized to the full, and industry now hopes to duplicate such achievements by means of non-scientific experimentation. The type of men chosen for such work may be gauged from the advertisements constantly appearing in the press. The following is a typical example: "Engineer, recent graduate preferred, to carry out research work." It may be assumed that a recent graduate is preferred because the expenditure will be small; but what can be expected from such a junior when his experience is, obviously, nil, and his outlook narrow and immature? Few men in such a category have the ability to record the results even if discoveries were made; and a wasteful repetition of work occurs.

The reason for the frequent failure of experimentation along definite channels is that commercial considerations force it to take a circumscribed path which must always be in direct line with the particular object sought. Immediate practical results are demanded, monthly or even weekly reports are usually insisted upon, and the immense value of definite although possibly unproductive progress is ignored. It is unfortunate that scientific research is not always undertaken in connection with subjects of more or less vital importance to industry and to the national advance or protection. But time spent on pure science is not wasted; for the scientific mind must be cultivated, and catholicity of interest is an important factor. Much good can be done by directing research along sensible channels without in any way circumscribing its efforts when work is once commenced.

The need for the co-ordination of science and industry has been much in evidence in connection with many industrial efforts, and several examples can be cited with reference to the metallurgy of gold and silver since the introduction of modern wet processes began to revolutionize precious-metal recovery. With the exhaustion of the majority of the known rich gold deposits in all parts of the world, problems had to be faced and solved as to the economical treatment of low-grade ore. Residues left from the more primitive operations and as the result of inefficient beneficiation became bonanzas with the passage of time. The ounce of gold has cost more and more to produce, largely on account of the increasing amount of rock, at times over 20 tons, which had to be mined, hoisted and hauled, crushed and re-ground, and finally treated by metallurgical or chemico-metallurgical methods in order to win that ounce of gold.

For the greater part of the latter half of the nineteenth century it was well known that gold was soluble in a solution of potassium or sodium cyanide. Some scientific research was done; but because the investigations lacked official encouragement or material assistance the work stopped at the first stage, and little attempt was made to discover or evolve a process for recovering the gold from the cyanide solution after it had been dissolved, or to ascertain if this first step in treatment could be accomplished without prohibitive expense, that is, with weak solutions. A syndicate of engineers, among whom was John Stewart MacArthur, made experiments in 1886 in an effort to discover such a process, and their investigations led to what may be termed one of the notable inventions of the century. In all their tests, however, success was gauged by a consideration as to whether or no actual gold could be produced by the method adopted—the gold had to be laid 'on the table'—and a neglect to appraise the real value of theoretical research resulted in faulty judgment and much delay. Various solvents, of a dilution indicating commercial practicability, were tried on the gold ore; and an evil-smelling gas—sulphuretted hydrogen—was used to precipitate the precious metal from the solutions resulting.

With weak cyanide solutions there was no result—no gold was precipitated—and the experiment was voted a failure. As a matter of fact, however, the first stage of a new process had been completely successful. But practical commercial results were being sought, as they invariably are in all industrial research, and a scientific fact of vast importance passed unnoticed and unrecorded. It was nearly a year later that an accidental discovery was made of the absence of gold in the residue from the original test; and it was then realized that the failure to lay the gold 'on the table' was due to the fact that the precipitant used—the sulphuretted hydrogen gas—was ineffective; and further tests then confirmed the con-

clusion that the gold had been readily dissolved in the first instance by means of a dilute solution—a feasible step from the commercial standpoint.

Had the haste of commercialism been replaced by the thoroughness of science the discovery of the cyanide process would undoubtedly have taken place a year earlier. But for an accident it might have been delayed for a decade or more, with economic consequences impossible to estimate. Patents were issued to MacArthur and his associates in 1888 which indicated the use of zinc-shaving as a precipitant of the gold which had been dissolved in the first stage of the process. These patents marked the complete specifications of a commercially feasible scheme for the treatment of low-grade ores.

With the introduction of the cyanide process came a revolution in the industry. Leaching plants were erected in New Zealand, that cradle of progressiveness, in 1889; and in 1890 in South Africa. In 1897 the cyanide process was mainly responsible for the fact that the world's yearly output of gold had been more than doubled within a decade. Much of the increase was due directly to the introduction of cyaniding, but much was also due to the circumstance that a wider field for the treatment of low-grade ores was presented by the standard method of amalgamation with mercury, followed by a cheap leaching with cyanide solution.

Soon after the introduction of the cyanide process it was found that the dissolved gold obtained by the treatment of the ore could be precipitated by passing the solution through lump charcoal, instead of through zinc-shaving. The charcoal cost practically nothing, and so there was a possibility of reducing considerably the expense of treatment; but the results were found to be unsatisfactory. An enormous amount of charcoal was needed to precipitate a small amount of gold, and the modification was never generally accepted as commercially feasible.

From the chemical point of view the reaction ought never to have happened. Discussions arose as to the cause of the precipitation, but no definite or satisfactory conclusion was reached that was generally acceptable. No scientific analysis or investigation was made; and after casual mention by engineers and college professors the innovation passed into the limbo of the impracticable. The question as to why the gold was precipitated on an apparently inert substance like charcoal was viewed as of academic and scientific interest only, and was soon dismissed as unworthy of further attention by those who were keenly interested in a phase of the process where enormous expenditures were being made for a metallic precipitant which was unrecoverable. Contradictory hypotheses were sporadically advanced from time to time, on which there was no umpire to pass judgment; and a lack of recognition of the value of purely scientific investigation and the obstinate retention of the idea that no theoretical questions were worth considering were together responsible for the postponement for a number of years of an important discovery. Had a trained mind been put in charge of research on the theory of the action —the purely scientific aspect of the question—there is no doubt that the cause of the precipitation would have been discovered almost at once; and there is also no doubt that the discovery would have immediately pointed a way to the practical utilization of charcoal as a precipitant under certain conditions.

Recently, after all these years, two Australian engineers, in an endeavor to effect a war-time economy, stumbled onto the fact that charcoal is suitable as a precipitant, and will under certain conditions prove an efficient substitute for the expensive metal usually used, by merely grinding it to a powder before use, instead of using it in lump form. The fact that the charcoal is more effective when finely divided gives the clue at once as to the reason for the precipitation—it was a physical rather than a chemical action. This hypothesis in definite form comes after many years of inaction and unnecessary expenditure. Had scientific research been applied to the problem in the first instance the cause of the phenomenon would have been discernible, and then the most efficient manner of utilizing the charcoal for the purpose would have suggested itself. In this instance physical action meant surficial action, and by increasing the surface—by reducing the size of the particles—the result is achieved. Theoretical research would, undoubtedly, have disclosed the conditions under which the adoption of the cheaper precipitant would have been practicable and advantageous.

The function of oxygen or air as an aid in dissolving gold by cyanide solution had been known for many years previous to the introduction of the MacArthur-Forrest cyanide process, the importance of oxygenation in this connection having been emphasized by Faraday in a scientific paper published in 1857. But from the time of the discovery of the cyanide process the profession has floundered along with little or no help from theoretical research. A purely scientific discussion invariably failed to create sustained interest, the connection between pure science and successful industry never having been recognized. A number of individual cyanide engineers spent odd hours in investigation and experiment, but none had the time nor the resources to carry the work to a logical conclusion. Occasional research, so-called, was undertaken by students at universities and schools of mines, but nothing definite resulted, and no complete study of the subject was ever made; no scientist was ever intrusted with the problem.

For nearly thirty years the function of oxygen or air in the various stages of the process (other than in dissolving the gold, and that was learnt from scientists) has remained an unheeded theory and beyond the interest of practical men. Hit-or-miss experimentation in some cases suggested that better results, irrespective of wastage, could be obtained by again adding *more* oxygen before the gold-cyanide solution reached the precipitation boxes; but as to any scientific interpretation of the variable results obtained in the many phases of the work, there was nothing but exasperating indecision. Textbooks carefully avoided the question.

Vacuum-filters were introduced at an early date to separate the ground or classified ore from the cyanide

solution that had been used to dissolve the gold; and a definite although unrecognized result of their adoption was the removal, by the abstractive action of the vacuum, of much of the air or oxygen from the solution before precipitation of the gold on zinc-shaving or zinc-dust. No convincing data were produced, however, and nothing was published along lines such as would inevitably have resulted from elementary scientific or theoretical research. The absence of any centralized effort in this direction led to much experimentation. Some plants had vacuum-filters and some had pressure-filters. Practice in some places resulted in good precipitation; in others, bad; there was no accounting for the results one way or the other. Varying efficiency was the outcome of apparently parallel operation; and a considerable amount of waste resulted of gold, solvent, precipitating material, and time. The climax was reached in 1918, that is, thirty years after the introduction of the cyanide process, when a patent was taken out by an American engineer who now claims a monopoly over a phase of operation which has been in regular use since the introduction of vacuum-filters, namely, the abstraction, by means of a vacuum, of air or oxygen from the unprecipitated solutions. The Patent-Office at Washington has, apparently, no technical advisers; and patents are issued whenever a search fails to reveal a prior grant.

Whatever the fault of the Patent-Office, however, it is evident that in the case under consideration the patentee was the first to insist that, by adopting the simple expedient of removing the oxygen or air, the efficiency of the process may be considerably increased; and marked economies of precipitant and solvent will result. In hundreds of plants this had been done unconsciously for many years. In other cases operators were wondering why their results were so erratic, why their costs were so high. In the absence of a sound foundation of fundamental principle the industry has muddled along, avoiding a definite line of research, and content with the empirical results of the unencouraged and unpaid efforts at improvement carried out in odd moments by zealous though inexperienced investigators, whose work was too often condemned by so-called practical men as an effort to 'get into the spotlight'. Had a real scientific investigation been placed in charge of a capable research chemist the industry would have been saved many millions of dollars; and waste, uncertainty, and the unnecessary expenditure of time and money, much of which was altogether unproductive and barren of result, or which merely indicated the duplication of futile effort, would have been avoided.

When there is a clear problem to be solved it is the scientist who is best equipped with knowledge of what has already been done, and who knows the particular line of research that should be undertaken to solve it. It was Humphry Davy, the scientist, who evolved the miners' safety-lamp. It indicates a paucity of intelligence to ignore what is owed to scientists, whose work carries them above the plane of aggressiveness that industry is wont to admire in this age of notoriety. It would be pitiable to belittle or discount the scientific side of Davy's invention which, above all others, has contributed to the safe working of that essential, coal. When it was suggested that he should patent the safety-lamp he refused, saying that wealth could not increase either his fame or his happiness. This is the scientific spirit.

Another aspect of the matter demands consideration. The decay in pure science and the attitude of disdain that is being taken toward it by industry and commerce is leading to a steady deterioration in the manner of presentation of non-scientific data of vital importance. With an almost entire elimination of pure science from curricula has come a turgidity of exposition that is deplorable. It is the great scientist who teaches us not only how to discover, but also to transmit the acquired knowledge with a clarity and simple beauty of expression that we all enjoy and envy. But this is merely an outward and visible sign of the inward and scientific mind. So long as science remains divorced from the resources and help of industry so long will many great truths remain hidden, and unsung in language befitting the achievement of their discovery. There may be no obvious problems to be solved but that fact constitutes no reason why scientific investigation should be decried. We must admit the verdict that we are no judges; we do not know what scientific research and men of science could do for us if ample opportunities were afforded for investigation. It is becoming more and more evident that the prejudices against pure science prevent us from adding, in an adequate manner, to the reserves of knowledge, other than by adapting to present-day needs the discoveries of the past. Other ground should be scientifically prospected in all directions. Much of the work may be barren of immediate result; but an endeavor should be made to prevent the economic waste that must inevitably occur when reliance on new discoveries is placed on the results of haphazard, hit-or-miss experimentation—often from duplicated effort in rival organizations—carried on without scientific guidance, and with no other object than immediate commercial gain.

A scientist should be considered as a valuable asset to any country, not as an individual of little practical worth, because he is too costly an investment and because he will not, and cannot, guarantee a return for money expended. It should be remembered that true scientific research is never unproductive of good; for one result, at least, is to inculcate a thoroughness of analysis, a breadth of view, and a clarity of deduction that is of inestimable value to the worker, his employer, and the nation.

Achievement along new lines necessitates, as a preliminary the abandonment of the present unreasoning attitude toward pure science; we must reject the idea that experimentation and research must be curtailed or carried out along paths with a pre-determined end in sight. Progress without true scientific research can only be accidental. With it, who knows what the future may have in store? The country that can afford to encourage the scientific mind, and then place its greatest scientists on research work in each phase of industry, with a free hand as to the line of action to be taken, and with ample resources, will find that commercial as well as intellectual

supremacy have been won. For few believe that the world has reached the zenith of great discovery.

Science needs and deserves encouragement, sympathy, and facilities. It must be allowed to work in freedom and without restraint. The provision of funds is not all that is necessary; for discovery is not an open book, to be read by the passer-by. It must be approached by men of keen analytical and dissective minds, men with experience, knowledge, perception, logic, and a capacity for unlimited perseverance. Three essentials are needed: the best men that can be found, ample resources, and patience as to results. If progress is desired, then nothing will be achieved by making research a means of livelihood for mediocrities. The true inquiring scientific spirit must be fostered in the first place, not discouraged as at present, then allowed ample opportunity for development. The greater the utilization of individual ability and keen scientific sense the less the time needed to uncover the hidden truths that the world needs.

The Turnover of Labor

Records show that there are few, if any, industries in which the turnover of labor is so large as in mining and metallurgical operations. Some of the features of the problem are discussed in a recent bulletin of the Federal Board for Vocational Education. Labor turnover is of import to employers chiefly because it costs money to replace separations. Gross separations cannot be depended upon to show the extent of harmful turnover, for the reason that such separations include lay-offs which ordinarily do not have to be replaced. The replaceable separations constitute, therefore, the only practical measurement of the extent of costly turnover.

The extent of labor turnover may be said to be a practical gauge for measuring the relative satisfactoriness of employment policies, general wages, and labor conditions. This is so because, aside from lay-offs, which by their very nature call for no replacement and constitute, therefore, no turnover, the two principal causes of turnover are discharges and voluntary resignations. Practically speaking, the extent of discharges indicates the relative ability of the management to carefully select, train, and manage its help. The relative frequency of resignations indicates in a practical manner the relative satisfactoriness of the labor and wage conditions in the establishment. Wage-earners whose principal source of livelihood is their daily job resign only when they are, for some reason or other, dissatisfied with their work and can, or think they can, obtain better positions. Labor turnover represents a definite, though not easily calculable, economic loss to the employer. The principal items entering into this loss are: (1) the clerical cost incident to firing and replacement; (2) the cost of training newly hired employees; (3) the wastage, breakage, etc., attributable directly to inexperience; (4) the maintenance of idle machinery and equipment while seperations are being replaced; (5) the decrease in the general efficiency in the organization due to the constant state of flux in the working force; and (6) the tendency on the part of new employees to increase the frequency and severity of accidents.

Turnover in an organization does not take place in an equal degree throughout. Some parts, such as, for instance, departments employing large numbers of new employees or casual workers without skill, usually have large turnover; others, employing, for instance, handy men with longer records of service, might have a medium turnover; while still others, such as those concerned with maintenance and employing old skilled mechanics, may be almost stationary.

The methods used in the computation of turnover will vary, of course, with the meaning of the term. If by labor turnover is meant, as in business, the general turnover of men—accessions as well as separations—or the labor flux—the extent of turnover will be measured by the ratio which the aggregate of accessions (hirings and re-hirings) and gross separations (discharges, resignations, deaths, marriages, etc.) will bear to the working force during a certain period, usually one full year. Some employment men see their turnover wholly in accessions or hirings, in which case the turnover is measured by the ratio of accessions to the working force. Others, however, think that gross separations constitute the best method for measuring turnover. In such a case the turnover extent is measured by the ratio of gross separations during the period to the working force. The various policies bearing upon the extent of the labor turnover in the working force may roughly be classified into two main groups: (1) methods of hiring, placement, and discharging, and (2) methods of reducing voluntary separations. The latter group may further be subdivided into: (*a*) wage policies and wage changes; (*b*) conditions of employment; and (*c*) agencies for the adjustment of grievances.

'Industrial medicine' is one of the most potent means of promoting efficiency of labor and has application to every branch of mining operations, according to Arthur L. Murray of the U. S. Bureau of Mines. In the selection and planning of camp-sites, the sanitary engineer is indispensable in determining adequate water supplies; methods of drainage including proper disposal of sewage; suitable housing arrangements as regards light, ventilation, and overcrowding; and provisions for the disposal of refuse and waste. In the selection of labor industrial medicine plays an important part. By careful study of working conditions, and the correction of conditions and causes leading to accidents and illness, much needless time loss may be eliminated. Through sanitation applied to mining camps or towns and the safeguarding of the conditions under which employees live, the general health of the community is promoted. Through medical welfare-work, especially by popular instruction in personal and public hygiene, much sickness with its resultant suffering and time loss may be prevented.

During the fiscal year ended June 30, 1920, 912,750 gold coins, 128,728,400 silver, and 603,942 minor coins were made by the U. S. Mint.

The Work on Mineral Resources Done by the United States Geological Survey

By EDSON S. BASTIN and H. D. McCASKEY

*The United States Geological Survey has been charged by Congress with many duties, but one of the most important is that of making an inventory of the country's mineral wealth as utilized in the industries. Considered in connection with this duty, the Survey may be described as an accountant whose task it is to know where the valuable mineral deposits of the United States are situated; what, if anything, they are contributing year by year or month by month to the economic life of the country; and, in a general way, what they may be counted upon to contribute in future years.

The mineral investigations of the Geological Survey fall naturally into three major groups. Those of one group, conducted by the division of geology, consist of the study, interpretation, and mapping of the geology of particular districts, of the discovery of mineral deposits, of the determination of their approximate magnitude and their suitability for industrial uses, and of the study of the natural conditions or processes that control their formation or that limit their development or extent. The mineral investigations of a second group, conducted by the division of mineral resources, consist in compiling a continuing statistical record of the mineral production of the country and in reporting new sources of minerals or new methods of their utilization. Within recent years a third group of the mineral investigations of the Geological Survey has consisted in the classification of the public lands with respect to their content of mineral wealth. This work finds immediate application in controlling the conditions under which such lands may be sold, leased, or utilized, but it has increased the knowledge of the country's mineral reserves, especially of those that are little developed or not developed at all.

The year 1918 was the thirty-seventh year of consecutive compilation of mineral statistics by the United States Geological Survey, and many of those who have contributed to the success of this work or have been benefited by it may welcome the following brief story of its development and its scope.

The first annual report of the Geological Survey on the country's mineral resources was that for the year 1882. It was specifically authorized by an act passed at the first session of the Forty-seventh Congress, and it was compiled under instructions issued August 5, 1882, by Maj. J. W. Powell, who had succeeded Clarence King as Director of the Geological Survey. Since then a systematic annual canvass of the mines, quarries, and oil and gas wells of the country has been made by a regularly organized division of the Survey, for many years known as the 'division of mining statistics and technology', later as the 'division of mining and mineral resources', and in more recent years as the 'division of mineral resources'. The first geologist in charge of the division was Albert Williams, Jr., and he had among his associates Charles G. Yale, in charge of the Pacific division and then editor of the 'Mining and Scientific Press', of San Francisco. Mr. Yale is still in charge of the San Francisco office of the Survey and probably is acquainted with more mining men on the Pacific Coast than any other man. Among other associates was David T. Day, who succeeded Mr. Williams in charge of the work in 1886 and remained as geologist in charge until 1907, when he was succeeded by one of the division staff, Edward W. Parker, who remained statistician in charge until his resignation from the Survey in 1915. Mr. Parker was in turn succeeded by his principal associate, H. D. McCaskey, who relieved him early in 1915 and continued as geologist in charge of the division until January 3, 1919, when he was relieved by Edson S. Bastin, the present geologist in charge. During the 37 years covered by this work, from late in 1882 to the end of 1919, the Survey has had only three directors, namely, J. W. Powell, Charles D. Walcott, and George Otis Smith; and the division has had only the five chiefs named above. This long-continued service has made for continuity of effort and for maintenance of worthy tradition and of esprit de corps, and as each administrative chief has been succeeded by a former associate the whole work has been marked by continuous and consistent growth.

It is interesting to recall, however, that the 'organic act' of the Survey—the act upon which the organization of the Geological Survey was laid out by the first Director, Clarence King, in 1880—provided for investigations of the country's mineral resources, and in the census for that year well-known geologists of the Survey, including S. F. Emmons, George F. Becker, and Raphael Pumpelly, assisted Mr. King in the first systematic statistical investigation of the mineral production of the United States. These men, with Henry Gannett and Whitman Cross, also of the early Survey staff, assisted in compiling the first report of the series now entitled 'Mineral Resources of the United States'.

The Geological Survey has directly and notably aided in the statistical canvass of mines and quarries in the four censuses taken since its organization—those for 1880, 1890, 1900, and 1910—and is now preparing to cooperate in the census for 1920. In the mineral census for 1880, conducted by the Survey at the request of the Census Bureau, the method of obtaining returns directly

*To be published in 'Mineral Resources', 1918. Part I.

from producers was first put into practice in a broad way. Cordial and effective relations with the entire mineral industry were then established by the Survey and have since been continued and widened.

After the statistical work was begun by Mr. Williams and during much of Dr. Day's administration a central staff in the Survey maintained current lists of mineral producers, sent out schedules, and compiled and tabulated the returns received, but many of the chapters were written on a contract or for an honorarium by specialists not on the permanent staff of the Survey and not residing in Washington, who gave only a part of their time to the work. In this way the Survey availed itself of the experience and knowledge of experts like John Birkinbine, as to iron; Charles Kirchoff, as to copper, lead, and zinc; and George F. Kunz, as to gems and precious stones. During the early part of this period, also, when the Survey's central force was small and when it was employing specialists who were engaged principally in other occupations and were not in constant touch with the statistical work, it was not always practicable to make the canvasses as complete as they were made in the first year (1880) and as they were again made in later years; but though some loss was thus suffered, some gain was made by the earlier publication of results.

To keep more closely in touch with the rapidly developing mineral industries and to cover every phase of economic and mining geology it was finally determined to revert to the plan of making a comprehensive and detailed statistical campaign in every mineral industry, similar to that made by the Survey for the census of 1880 but on a much larger scale. It was arranged to develop specialists from the economic geologists and trained engineers and statisticians of the permanent staff of the Survey and to re-establish permanent Western offices. Waldemar Lindgren undertook the reorganization of the work on metals and really became successor to Clarence King in directing the investigation, both geologic and statistical, of the precious metals, of copper, lead, and zinc, and of the rare metals. He organized the Survey's offices in Denver, Salt Lake City, and San Francisco and brought them into close contact with the metal-mining industries, except the iron industry. About this time Mr. Parker succeeded Dr. Day in charge of the mineral statistical work. With the appointment of selected specialists from the Survey staff for every commodity and with several accessions to the trained statistical and clerical staff, the statistical work was made more complete and accurate and was supplemented by field-work done by trained economic geologists. Thus we find the organization today, with some changes in personnel, bringing to its task the strength gained by the continued development of methods and of men and by intimate professional contact with the mining industry during a period of nearly 40 years.

From 1880 to the end of 1918 the value of the mineral production of the United States has increased from $367,000,000 to more than $5,500,000,000, nearly 15 times, or, measured in another way, from a little over $7 per capita to more than $52. The funds allotted for measuring this production have increased from $10,000 in 1890 to $100,000 in the year 1918-19, or only 10 times. The staff in 1918 numbered 32 technically trained specialists, most of them geologists and mining engineers, of whom 12 devoted their entire time to the mineral statistical work and the remainder devoted some of their time to geologic studies. In addition, 43 stenographers and clerks, many of them highly trained in statistical work, were employed for full time.

As the statistical work has grown in magnitude it has tended to absorb a larger and larger share of the time of specialists who were expected to devote only part of their time to it. Many geologists who have enjoyed the 'touch with the practical' which the work on mineral resources affords have found themselves forced by the growth of the mineral industries to devote their full time to the work and to abandon their chosen scientific labors. This condition has greatly retarded the geologic work of these members of the Survey, who have been unable to finish extensive and important field investigations. Recently a remedy for this condition has been sought in the selection for work on mineral resources of persons willing to devote their entire time to it, and the new grade of 'mineral geographer', established early in 1919, is designed to furnish, through the civil-service system, eligibles for this work.

The field covered by the intimately interlocking activities of the Survey in the investigation of the mineral resources of the United States now includes every known raw mineral product and commodity of economic value and anticipates future development by including some rocks and minerals that are of no present economic value but that may be valuable in the future. The Survey's lists of mineral operators now contain more than 110,000 names and addresses, including operators of mines, quarries, wells, mills, smelters, and refineries, all of whom are in direct touch with the Survey, not only supplying information, but also receiving it. The work has received international recognition as the most complete governmental investigation of mineral industries yet made, and Congress has repeatedly given it approval and the substantial recognition of increased, though still inadequate, funds and facilities.

In all its investigations of mineral resources the Survey has aimed to avoid duplication of work by co-operating as closely as practicable with other Federal bureaus and offices, particularly with those that are doing statistical work or that are especially interested in mineral statistics, such as the bureaus of mines, standards, and foreign and domestic commerce, and the Mint. Many tradebodies and 18 State organizations also co-operate with the Survey in work on mineral statistics, and co-operation will be extended to other States as rapidly as they make funds or facilities available for their share of the work. The Geological Survey recognizes, too, that a statistical service organized for the benefit of the mineral industries should impose no unnecessary burdens upon those industries and has therefore avoided the unnecessary multiplication of requests for the same data.

At the beginning of the war in Europe in 1914 the

Survey, as it had compiled a mass of data on domestic mineral resources and some on foreign resources, and was in intimate contact with all branches of the mineral industries, was able to furnish the public with much information relating to the raw materials needed to fill orders for war material from Europe. The rapid increase in the number of inquiries made during the War showed the usefulness of the work performed. Little has been published concerning the great and highly diversified war work of the Geological Survey, which extended through many mineral industries and through all the Federal departments, for it has been held throughout the Survey that this work was a privilege not to be cheapened for self-glorification or loudly exploited as an exhibition of patriotism. Now that the War is over, the Survey's work in it may be more freely mentioned, and, in justice to the men who aided in it, an account of it should form a part of every complete record of the participation of the United States in the War.

When the United States entered the War the Survey was immediately called upon to assist the War and Navy departments and many new war boards, especially the Council of National Defense, the War Industries Board, the War Trade Board, the Shipping Board, and the Capital Issues Committee, in their rapidly expanding war activities. With no increase in appropriation and, for most subjects or materials, no increase in technical or clerical staff, the statistics of several mineral resources were collected not annually, as before, but quarterly, monthly, or even weekly. This expansion was made possible only through the complete sacrifice of all the purely scientific work that had before occupied a part of the time of most of the mineral-resources specialists and through longer hours of more strenuous labor by the specialists and clerks.

The Survey furnished rooms and other facilities for mineral committees of the War Industries, War Trade, and Shipping boards and for the interdepartmental Joint Information Board on Minerals and Derivatives, adjacent to its own specialists and records, and thus and in other ways aided the numerous war organizations in finding their way to effective work. By establishing this intimate contact with the organizations that needed information concerning minerals, comparable to its intimate contact for many years with the industries that supply the information, the Survey had a unique opportunity to be of larger use—an opportunity of which it gladly availed itself to the limit of its ability.

The experience gained by the Survey during the War and the growth of the demand for mineral-statistics have shown the need of expanding this work so that it may include the preparation of more detailed and frequent current domestic statistics and more exhaustive research into foreign mineral resources. To adapt the organization to its changing responsibilities the Director of the Survey provided for a larger service, effective at the beginning of 1919. The most noteworthy part of this provision, perhaps, has been the establishment within the division of mineral resources of a section of foreign mineral deposits, charged with the assembling, mainly from the official reports of foreign governments, of statistics of mineral production, imports, and exports and with the compilation, from both public and private sources, of information showing the location and size of foreign mineral deposits, particularly those that contribute to our own mineral imports or that compete with our mineral exports. The interest and co-operation of some large American companies that are interested in foreign mineral deposits have already been enlisted in this great work, but as only a small fund and personnel are available for its prosecution it has merely been begun. In the work on both foreign and domestic mineral resources the Geological Survey needs the continued and increased support of the public and of Congress that it may go forward confidently to larger and more effective service.

The World's Production of Gold

The United States Geological Survey has given out some preliminary figures showing the production of gold throughout the world in 1919. The production in the United States was $58,285,196; Canada is reported to have produced $14,687,000; India $10,028,000; Australia (not including New Zealand or the Islands), $29,268,000; the Transvaal, $171,640,123; Rhodesia and West Africa, $18,631,070. There was a probably large decrease in the production of gold in Russia and Siberia in 1919. Some increase was probably made in the output of Central America and South America, which, however, was doubtless offset by decreases in the output of other countries. The incomplete returns now available indicate that the world's production of gold in 1919 was between $345,000,000 and $350,000,000. The world's production in 1918 amounted to $380,924,500. The Geological Survey further states that information received during the first six months of 1920 indicates a still further decrease in the production of gold in the United States and that the output for the year will probably be less than $50,000,000. The production in Alaska, Colorado, California, Oregon, and Montana will be much less in 1920 than it was in 1919, because water is very short for placer mining and many stamp-mills are closed. Canada as a whole may increase its output, although the production of the Yukon districts will be smaller than last year. The output of Russia cannot be estimated. That of Australia will show a decrease. That of South Africa and South America will probably show no radical decrease. According to the Geological Survey, the indications are that the decrease in the world's production of gold in 1920 will not be so great as it was in 1919. [Our estimate of the world's output of gold in 1919 was $350,044,489, as given in our issue of May 8, 1920.—Editor.]

Between January 1 and March 31, 1920, inclusive, 4899 flasks of quicksilver, each of 75 lb. net, was produced in the United States. This is 852 flasks less than the output in the fourth quarter of 1919 and 1226 flasks less than that in the first quarter of 1919.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

VALUATION OF MINING PROPERTY IN THE STATE.

PHOENIX.—The State Tax Commission has announced the valuation of Arizona mines as $389,029,919, which is $25,000,000 less than the valuation for 1919. Five new properties put a half million dollars valuation on the books this year, but the reduced total is due to the large number of small mines which have closed down, owing to the condition of the copper market, and to the fact that many of the large properties were working only at 35 to 60% of full capacity. It is interesting to note from the statement of the Tax Commission that there are at present 43 producing mines in the State of Arizona.

The highest valuation placed on any property was that of the Copper Queen branch of the Phelps Dodge Corporation, which amounted to $65,394,204, being an increase over the 1919 figures, of nearly two millions. The Inspiration property in the Globe-Miami district was assessed at $65,372,690, being a reduction of almost eight millions from the 1919 valuation. The Calumet & Arizona Mining Co.'s valuation was increased approximately two millions over last year, while the figures for the United Verde Copper Co., and United Verde Extension Mining Co. show a decrease of $3,800,000, and $2,400,000, respectively, from the 1919 assessment.

BISBEE.—It is anticipated that the new 4000-ton mill for handling the concentrating ore of Sacramento hill will be completed early next year. Rapid progress has been made in removal of waste capping over the orebodies and it is estimated that when production commences, early in 1921, approximately 6,167,000 cu. yd. will have been removed; 71% of the waste stripping necessary before ore production starts was complete at the end of last April.

The ventilating shaft, being sunk by the Calumet & Arizona Mining Co. below its Briggs shaft, is going down at a remarkable rate. The log during the last week showed an average of 10 ft. per day or 70 ft. for the week. The shaft has now reached a depth of approximately 385 ft. An aftermath of the 'Bisbee Deportation' cases was the recent issuance of summons from the Superior Court at Tombstone in 37 civil cases, complaints in which were filed a year ago, and which arose from the deportation of July 1917. With the issuance of these summons there are now more than 500 civil cases pending, the amounts claimed for damages ranging from $10,000 to $75,000. Taking $25,000 as an average claim, the total amount claimed would be in the neighborhood of $12,500,000. The defendants in the last 37 cases filed include all the large mining companies in the Bisbee-Warren district, as well as a number of prominent citizens.

JEROME.—As previously announced, the plant of the Jerome-Superior Copper Co., near the Hopewell tunnel, is being electrified throughout. This means the installation of thousands of dollars worth of new machinery and the removal of much of the present steam plant. There are at present 57 men on the payroll, not including the electrician and crew of five men imported from Prescott who will do the electrical work under contract. The depth of the shaft is approximately 860 ft. and steady progress is being made in sinking, despite the great volume of water. Quartz porphyry is the formation in which the shaft is bottomed. It is the present intention to sink to a depth of at least 1000 ft. before doing any more lateral work, and if indications are not satisfactory at that level sinking will continue as the plant is capable of carrying the shaft down to 2000 ft. if necessary. The pumps are lifting an average of 160,000 gal. every 24 hours. The flow is steadily increasing as the shaft gains depth, due no doubt to the big sheared zone. A big pump for installation on the 1000-ft. level, or above, if needed, is already on the ground. Machinery for a water-softening and cooling plant is at Clarkdale and will be hauled out to the Jerome-Superior at once. This plant will take most of the lime out of the water and thus greatly improve it for domestic and other purposes.

The latest report from the Shea Copper Co. advises that the tunnel has attained a length of slightly more than 100 ft., and that work is progressing favorably. The tunnel is now 280 ft. from the shaft and a raise will be started at once, in order to cut the orebody.

One of the most spectacular fires ever seen in the Jerome district, occurred the latter part of this week when the old coke-bins of the United Verde Copper Co. were destroyed by fire, supposedly caused by cinders from a passing engine. Simultaneously the pipe, leading from the oil-tanks opposite the bins, broke and some 5000 gal. of fuel-oil added to the fire. No. 3 power-house stands close to the site of the bins and this structure was in serious danger more than once, but was saved by good work on the part of the mine fire-fighting crew.

H. P. Henderson, consulting engineer for the Jerome-Verde Co. recently issued a report on conditions at the mine in which the necessity for re-financing the company is urged. It is recommended that development work be

continued on the 1200-ft. level of the Main Top orebody, which has already produced over $157,000. Under date of March 12 a report was submitted to stockholders calling attention to the condition of the mine, the desirability of continued development, the financial condition of the company, and the immediate need of additional operating funds. Mr. Henderson advises that "complete cessation of operations would result in much damage through flooding of the workings and caving. Therefore to ensure the continuance of operations and to safeguard their own interests, the stockholders must act without delay".

SUPERIOR.—A road is being constructed between Superior and Miami, the completion of which will shorten the distance between Phoenix and Miami by about 25 miles. One of the novel features will be the driving of two tunnels, one 240 ft. in length, and the other 270 ft. Work will be commenced from both ends of each tunnel, thus providing labor for four crews. In certain sections the cost will approximate $250,000 per mile, on account of the heavy construction.

COLORADO

CANADIAN SYNDICATE TO OPERATE AT IDAHO SPRINGS.

IDAHO SPRINGS.—A Canadian syndicate has taken over the Gem and Silver Age mines in Clear Creek. Re-timbering of the Gem shaft has commenced and equipment ordered. The development will start on the Silver Age. Ben McDougal is in charge of operations with R. B. Lamb as consulting engineer. W. E. Renshaw of Idaho Springs is president of the mining syndicate, Sir Henry M. Pollatt of Toronto, president of the Mining Corporation of Canada, is chairman of the board of directors.

ASPEN.—Unwatering of the Smuggler mine by air-lifts is progressing and a gain of three feet daily is reported. More lifts will be used when additional power is secured. As levels are recovered the ground will be operated either by the leasing company or by sub-lessees. All levels down to the ninth are said to have silver-lead ore exposed that will pay well at present prices. Other properties on Smuggler mountain will become active when the Smuggler is unwatered.

SILVERTON.—The Martin Mining & Power Co. is preparing to resume on its properties the Golden Fleece, Gold Lion, Jennie R., and Tom Moore in the Picayune basin near Eureka in the San Juan. Samuel G. Martin of New York, formerly of Aspen, is now in Denver purchasing machinery and equipment.

BRECKENRIDGE.—G. W. Morgan lessee of the Brooks-Snyder on Shock hill has opened up a vein containing six inches of chloride ore sampling between 300 and 400 oz. silver per ton. A sacked shipment will be sent forward to the A. V. smelter at Leadville, this week. The Quandry Queen is shipping high-grade silver-lead ore. Three feet of the six-foot vein has a high silver content. Wellington Mines continues shipping zinc concentrate and last week loaded out four cars of lead concentrate, the first lead shipped for several months. The company, like others, is working short-handed.

The Dianthia property has been taken under lease and a cross-cut tunnel has been started to cut the vein below the present workings that, when operated last year, produced light tonnage of high-grade ore.

An electric hoist has been installed at the Deep shaft, Shock hill, and power will be turned on by the Colorado Power Co. as soon as the power-line can be connected. A pumping plant, electrically operated, will also be installed. Water is standing at the 300-ft. level, where work will start.

LEADVILLE.—The Penrose shaft of the Down Town Mines continues heavy production of silver-iron ore and lead carbonate to the Pueblo and Durango smelters and zinc carbonate to the Western Zinc Oxide Co.'s Leadville plant. Improvements to the District mill are progressing. New machinery is being installed and ore handling facilities added. The mill will treat ore from the C. and G. lease, of which John Cortellini is manager, and it is estimated the lease will keep the mill running at a capacity of 150 tons per day.

BOULDER.—The Keystone mill is again in operation and stopes and dumps at the Keystone mine have thus far furnished ore for tests, in which flotation is first used in the treatment, while concentration later is used on the tailing and slime. Preliminary runs are reported to show greatly increased saving but the light gold content in the Keystone ore, it is said, has so far not been recovered.

MICHIGAN

FRANKLIN COMPANY LEVIES ASSESSMENT.

HOUGHTON.—Production in refined copper by the Calumet & Hecla mines shows an increase for June of 219,068 lb. The output for June follows: Calumet & Hecla, 5,097,594; Ahmeek, 1,773,200; Isle Royale, 878,508; Allouez, 333,800; Osceola, 661,500; Centennial, 86,000; White Pine, 160,077; Superior, 32,000; total, 9,022,877. The May production for Calumet was 4,920,786; Ahmeek, 1,652,900; Isle Royale, 851,200; Allouez, 367,100; Osceola, 739,500; Centennial, 65,100; White Pine, 184,625; LaSalle, 22,600; total, 8,803,811. The production of Calumet in June included 1,279,491 lb. of copper recovered by the reclamation-plant. Calumet & Hecla has begun work on an order for 1500 tons of copper for France and a consignment of 500 tons left here recently for Montreal for trans-shipment to European markets. A steamer is expected this week and will take out 1600 tons for Eastern markets, chiefly Buffalo. The metal for France is special-order copper, consisting of billets and wire bars.

The Franklin Mining Co. announces that financial and operating conditions compel the calling of an assessment of $2 per share, due August 12 by shareholders of record August 11. The company's announcement says: "The mine must be kept free of water and the plant in condition to resume operations because the recent underground developments warrant the resumption of production as soon as normal conditions again prevail in the copper industry. Our bankers say the cost of this should be car-

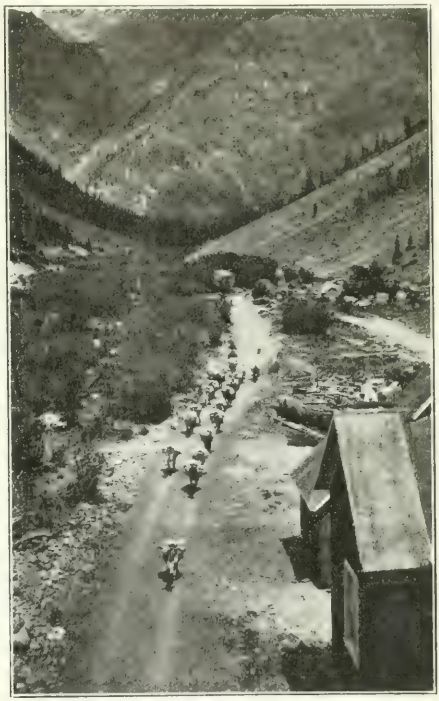
ried by stockholders, which cannot well be denied. Developments since the first of the year have proved a long stretch (650 ft.) of good ground at the bottom of the 39th level on the Pewabic amygdaloid. It is undoubtedly better than any similar ground heretofore opened. There are excellent reasons for the belief that the ore will continue and probably improve as drifting proceeds north. This theory is corroborated by the fact that the 30th level is better at 1600 ft. than it is at 600. It costs but little more to continue this development a the bottom of the mine than it does simply to provide for the absolutely necessary pumping; consequently, development there should proceed while the price of copper is low, as every foot of new ground opened will be a big asset when production is resumed."

Mayflower-Old Colony has opened a good quality of ground in its south drift since the work was resumed in this direction. The raise in the west cross-cut also has started and is breasted in trap formation. There is a hope that this opening will encounter the Mayflower lode as it proceeds upward and, in this event, the development of the vein will be possible with less difficulty. To the north, the cross-cut continues in the conglomerate lode, the same formation that was entered by the cross-cut 140 ft. farther west, and 320 ft. from the shaft. Altogether Mayflower has close to 1000 ft. of openings on the 1700-ft. level and it may be that an equal amount of exploration will be necessary before the work on this level is complete.

The employees of Allouez and Centennial have been absorbed by Ahmeek and Kearsarge, principally, while a few have been given positions in the Calumet conglomerate and at the C. & H. mills. The result will be an increase in tonnage for Ahmeek, Kearsarge, and Calumet proper, in July or until the two mines resume. Both mines are maintaining substantial crews for repair work, so when the time comes to re-open there will be no delay. The Calumet & Hecla company reports that from 20 to 25 former employees are returning each week from the automobile manufacturing centres, and whenever possible they are being given their old positions. Other workmen also are finding their way north, so the mines are gaining slightly in man-power. To offset the number who are returning, other miners and trammers who own farms are going back to complete the harvest, but in the fall they will return to the mines. In connection with the efforts of the mining companies to hold their workers, no operator, perhaps, has introduced such successful methods as Calumet & Hecla. Among other innovations, the company this year plowed and harrowed three immense tracts of land and turned them over to employees without cost to them. Practically every inch of the ground has been converted into garden space and at any hour of the day hundreds of men, women, and children can be seen at work on their miniature farms. The result will be a considerable saving to the employees, for many of them market the products that are in excess of what they require for themselves.

Calumet is speeding up the dismantling of the old Tamarack mill and as soon as the site is cleared, the erection of the leaching-plant will begin. At the Tamarack mine No. 3 hoist still is being dismantled and as rapidly as the parts arrive at Isle Royale the machinery is being set up in No. 5 engine-house. A delay has been noted in the shipment of steel for the addition to the Calumet flotation-plant, but delivery is expected before the end of the month.

No. 4 shaft, Wolverine, has been re-opened after a suspension of about 20 days, and shipments are divided



A PACK-TRAIN GOING TO SILVERTON, COLORADO

between this and No. 3 shaft. The Wolverine rock is still stamped in the Mohawk mill, however, with about 1½ heads allotted to Wolverine. In the meantime the bins in the Wolverine mill are being overhauled. The suspension of work in the shaft was necessary in order to remove the old concrete supports and install timber, on the 26th, 27th, and 28th levels. In practically every mine on the lake, concrete pillars are being discarded and there is little likelihood that anything other than timber ever will be used again. The concrete experiment has cost the Lake Superior mines hundreds of thousands of dollars, but practically every mine manager has been convinced that a cement composition cannot withstand the constant shifting of the ground. With every earth movement the concrete cracks or crumbles and unless it is removed at once it invariably becomes a menace to the safety of the employees.

MONTANA

GOLDSMITH MINE IS PRODUCING.

WICKES.—The Mount Washington mine is again shipping ore. Work on the mill has been delayed by the difficulty in getting the needed material.

WALKERVILLE.—The Crystal Copper Co. operating the Goldsmith mine is now shipping 100 tons of silver-gold ore per week; 50 men are employed. The ore is from development work on the 500-ft. level and from stopes on the 600-ft. level. New ore-bins have been constructed. A railroad spur has been extended to the property to eliminate the use of haulage by team. M. W. Anderson is in charge.

BUTTE.—Butte & Superior produced during June 8,250,000 lb. of zinc concentrate compared with 5,900,000 lb. for the month of May. North Butte produced 1,616,822 lb. of copper in June. Indications for July are that the 2,000,000-lb. mark will be exceeded. Development work continues to centralize on the Edith May vein on the 3600-ft. level. Cross-cutting toward this orebody is well under way.

TOWNSEND.—A 2000-ft. development tunnel has been completed at the Iron Mask mine in search of a high-grade lead orebody. A 100-ft. drift is now being driven at an angle to this tunnel which it is expected will cut the mineral zone.

COOKE CITY.—Work on the road to Gardiner is well under way with a crew of 10 men and engineers. It is planned to finish some rock construction at the Gardiner end of the highway during the coming winter.

HELENA.—Messrs. Johnson, Gerald, and Weisner have taken a lease on the Sunset mine in the Lump Gulch district. Pay-ore is expected at a depth of 100 ft. where 45 ft. of cross-cutting to the south should reach the main vein. Surface work has indicated rich silver ore.

NEVADA

TONOPAH-BELMONT WILL RE-TREAT TAILING AT MILLERS.

BEOWAWE.—Machinery and supplies are being hauled to the Cortez, on the Lander-Eureka county line, 35 miles south of here. The Arctic, or lower tunnel, 3000 ft. distant and 300 ft. lower than the 3700-ft. Garrison, or main tunnel of the old workings, has been put in condition for continuing it 600 to 800 ft. The present length is 1400 ft. All of the old machinery at the mine is worthless and an entire new plant has been bought. The Arctic is a double-tracked cross-cut tunnel and by continuing it the extension of ore in a winze from the Garrison tunnel can be opened. Practically all of the ore in the mine is in this winze. It is estimated that 75,000 ft. of work, exclusive of stoping, was done in the Garrison, Premium, Fitzgerald, and Arctic claims by the former owners. These claims were developed by raises from the main-tunnel level. The ore contains gold, silver, and lead. The gold is native or is associated with iron pyrite, the lead is found as galena and the silver is in the form of horn-silver or silver glance. The ore in the winze and in the dumps is estimated to have a recoverable value of $1,737,000.

SUNSHINE.—Gold-silver-copper ore is being shipped from the Sunshine district, 17 miles south of Winnemucca, by the Sunshine Mines Co. The ore is in fissure veins in limestone that contain silver sulphide in quartz. A tunnel is being driven with power-drills to cut these veins under the present workings.

VIRGINIA CITY.—Seams of quartz 6 in. to 3 ft. wide and assaying as high as $12 are being cut in a 400-ft. cross-cut from the 550-ft. shaft of the Comstock Silver, operating on the Brunswick lode in the south-eastern part of the district. The company owns four claims and has a lease on adjoining ground. The objective of the cross-cut is the Occidental fissure, in which little work has been done. The same management is to start work on the Comstock Phoenix, in the Sixmile canyon part of the district. The Comstock Phoenix has produced $400,000 to the 550-ft. level. The shaft is 550 ft. deep and a winze from the bottom level reaches 800 ft. The company will re-open and prospect further from the bottom of the winze and will continue sinking to 1200 feet.

TONOPAH.—The Belmont mill at Millers is to be re-opened to re-treat the tailing. The plant has been closed for more than five years, or since the mill of the company in Tonopah was started. It is reported that a process has been devised by Albert Siler, metallurgist for the company, by which the material can be treated at a profit. It is understood that the Tonopah Mining Co. made an unsuccessful attempt to treat the tailing at the Millers plant of that company before it was closed three years ago.

AUSTIN.—Hubert W. Rast is preparing to start shipping ochre from a mine owned by him near Walters station on the Nevada Central railroad. Rast says a San Francisco paint company has closed a contract with him, agreeing to pay $35 per ton f.o.b. Walters station.

OSCEOLA.—Silver-lead ore richer than the low-grade material found heretofore has been opened in a raise from a 145-ft. cross-cut on the 100-ft. level of the Lucky Boy, near Osceola, 46 miles south-east of Ely. There is enough ore in the shaft workings and a 350-ft. tunnel, with 700 tons of $20 ore on the dump, to justify the erection of a 100-ton concentrator, and a plant is now being built. The mine machinery includes a hoist that can lift from 400 ft. and an air-compressor. The ore in the raise is a sulphide in a granite pegmatite vein.

BLACK MOUNTAIN.—Ore assaying $75 in silver and lead has been found 30 ft. from the portal of a tunnel being driven by the Black Mountain Silver Mining Co. in the Marietta district, 12 miles west of Belleville, in the south-western part of Mineral county. A shallow shaft was sunk in the Black vein, 20 ft. wide, and a 1-ft. seam of ore assaying 150 to 200 oz. silver and 20% lead was opened. The tunnel will cut this vein at a depth of 140 feet.

MONTEZUMA.—The Montezuma Silver Mines Corporation has announced that the 400-ft. inclined Arizona shaft is to be sunk to 1000 ft. A 34-hp. hoist and a 36-ft. head-frame have been ordered for this work. Ore assaying

$25@ in silver, lead, and copper is being sacked for shipment from a 4 to 10-in. seam on the 400-ft. level. A 30-in. width assaying $16 to $35 also is being stoped on this level and a carload shipment of both grades is to be made. The rich ore contains 12 to 14% copper, $6 to $9 in gold, and 4% zinc. Sinking of the 245-ft. Caracas shaft, 1¼ miles from the Arizona, is to be resumed. Work is to be started after an idleness of many years by the Washington Montezuma. This company has a 220-ft. shaft on the claims.

GOLDFIELD.—The agreement for the organization of the Deep Mines has been ratified by all of the companies involved. Contrary to widely circulated reports, the proposed shaft of the Deep Mines has not been started and, except that it will be on or near the Blue Bull claims, so far as known a location for the shaft has not been selected. J. B. Humphrey and O. K. Reed, cattlemen, and others are buying supplies to be used in sinking a shaft near the Five to One tunnel. Humphrey and Reed have offered to invest $10,000 in the Five to One, but their offer was rejected, as the company has ample funds to continue work. The tunnel is now nearly 500 ft. long. Ore 3½ ft. wide, containing some gold, has been found by cross-cutting 60 ft. into the foot-wall of the vein in the Red Hill lease on the Florence. The find was made a short distance below the 400-ft. level. This is the only shoot of high-grade ore exposed in the Florence at the present time.

THE ANACONDA COMPANY'S COMPRESSOR PLANT AND VARIOUS MINES ON ANACONDA HILL

UTAH

MINING COMPANIES OPPOSE INCREASE IN POWER-RATES.

SALT LAKE CITY.—Hearings have been conducted by the Public Utilities Commission of Utah in the matter of proposed increases in rates for power furnished by the Utah Power & Light Co. to most of the corporations in the State, including the mining companies. The Utah Power & Light Co. was organized in 1912, and D. C. Jackling was elected president, holding that office until January 1, 1920, when he resigned. Lafayette Hanchett, formerly general manager for the Boston Consolidated Mining Co., which company was taken over by the Utah Copper Co. in February 1910 was elected as successor to Mr. Jackling. When the Power company was organized, it took over a number of plants in Utah, Idaho, and Colorado, and acquired several hydro-electric plant sites in those States. The company entered into long-time agreements for power service with practically all of the largest industries in this State. As a result of these agreements, several of the largest mining companies, it is alleged, discontinued operation of their own plants, or relinquished opportunities that they had to acquire sites for hydro-electric plants. Owing to the mounting costs of labor and supplies, officials and attorneys of the Power company claim that 60% of their power is being sold, at the present time, for less than the cost of production. The mining companies and other industries are opposing the proposed heavy increased rates, on the ground that the Public Utilities Commission cannot abrogate contracts entered into in good faith, and several of the largest companies are preparing plans for power-plants of their own. Some of the largest increases proposed for mining companies holding special contracts are as follows, the figures given being the amounts paid for power in 1919, and what the contemplated rates, for the same period, would have been: Spring Canyon Coal Co., $17,000 to $33,000; Chief

Consolidated Mining Co., $69,000 to $107,000; Judge Mining & Smelting Co., $48,000 to $93,000; Silver King Coalition Mines Co., $38,000 to $83,000; Silver King Consolidated Mining Co., $10,000 to $17,000; Utah Consolidated Mining Co., $41,000 to $76,000; Utah Copper Co., $667,000 to $1,515,000; American Smelting & Refining Co., $29,000 to $44,000; United States Smelting Co., $52,000 to $116,000. On July 30, attorneys of both sides filed written briefs with the Commission and commenced oral arguments.

There is at present a great scarcity of metal miners in the State, according to Carl A. Allen of the State Industrial Commission. Mr. Allen believes that many metal miners have heard the call of the coal mines, especially those of the Middle West, which are offering better wages than those paid in the local metal mines. At the present time Mr. Allen believes that many former metal miners are hiring out as harvest hands, as many of the men consider that the time spent in the fields is in the nature of a vacation.

PARK CITY.—Ore shipments from this camp for the week ending July 17 totalled 2267 tons, as compared with 2094 tons for the previous week. There are now eight regular shippers. The Ontario shipped 725 tons; Judge M. & S., 432 tons; Silver King Coalition, 337 tons; Daly West, 241 tons; Daly Mining, 101 tons; Naildriver, 115 tons, and the Keystone, 110 tons. The Judge smelter shipped 206 tons of premium spelter during the week.

Directors of the Glenallen property have levied an assessment of one cent per share. For the past few weeks, development work at the property has been at a standstill, and in order to secure the additional machinery to equip the mill, it was necessary to levy the assessment. James B. Allen states that there is considerable ore awaiting the completion of the mill. On account of the high-zinc content of the ore from this property, it does not pay to ship direct to the smelter, notwithstanding the high silver-lead content. The work of driving the Spiro tunnel is going ahead at a good rate, two shifts per day now being employed. The raise in the tunnel is reported to be advanced 50 ft., with indications that ore will soon be cut. The face of the tunnel is now in more than 12,000 ft. from the portal.

Conditions at the Ontario mine are promising, according to Clarence Bamberger, one of the officials of the company. The mine has been entirely re-equipped with electrical facilities and all of the old steam equipment has been abandoned. For the first time in more than twenty years, the 2000-ft. level has been opened and development work of importance will be undertaken. An inside electric hoist and a large skip has been installed for this work. The level has been opened for 400 ft. on the west side and 350 ft. on the east side, the object of the development work being to find good shoots of silver ore cut on the 1700 and 1800-ft. levels. The ore-shoot recently entered by a drift on the 1800-ft. level carries from 40 to 60 oz. of silver per ton. It has been developed on both sides of the 1800-ft. level and the full floor of the drift is in this class of material.

EUREKA.—Work on the new concentrator of the Tintic Standard company is progressing rapidly, and the buildings themselves will be completed soon after August 1. The setting of the machinery will then be started and the first section will be ready for operation before winter. Shipments from this district for the week ending July 17 totalled 136 cars, as against 81 cars for the week previous. The Chief Consolidated shipped 36 cars; Tintic Standard, 30; Eagle & Blue Bell, 10; Grand Central, 9; Dragon Con., 8; Iron King, 7; Victoria, 7; Centennial Eureka, 6; Mammoth, 6; Iron Blossom, 6; Gemini, 3; Tintic Drain Tunnel, 2; Colorado, 2; Bullion Beck, 2; Gold Chain, 1; Swansea Con., 1. At a meeting of the directors of the Pinion Queen Mining Co., E. J. Raddatz was elected president, to succeed Thomas F. Pierpont, who resigned. Development at this property is going along smoothly and the contractors are still using two shifts in sinking. The shaft now has a depth of about 700 ft., and sinking will continue until the 1000-ft. level is reached, unless the formation at some place between those levels justifies lateral development.

The Tintic drain-tunnel, which is being driven for the purpose of draining the district, is now in a distance of nearly 7000 ft., and there is no intention of stopping the work until the project is completed. A force of miners is now engaged in driving a raise to the surface for the purpose of giving better ventilation, this raise being started at a point about 6000 ft. from the portal. After a delay of thirty days, work of sinking the Central Standard shaft has been resumed. A large sump has just been completed on the 400-ft. level and John Taylor, manager, believes that trouble from water is now ended for all time. Two shifts are now being employed in the shaft-sinking, and excellent progress is made. The formation which the shaft is cutting is highly mineralized, and it is the intention to continue sinking to the 700-ft. level, when drifts will be sent out.

Conditions in the headings, which are being driven in the upper workings of the Uncle Sam and May Day mines, are promising, according to George H. Dern, general manager.

BRITISH COLUMBIA

OUTPUT FOR THE YEAR 1919

VICTORIA. The monetary value of the mineral output of British Columbia for the year 1919 was $33,296,313, as compared with $41,782,474 for 1918 as shown by the official figures given in the annual report of the Minister of Mines. The comparison is shown in the following table:

	1918		1919	
	Quantity	Value	Quantity	Value
	Oz.		Oz.	
[illegible]	16,000	$ 8,320,000	11,325	$286,500
Gold, lode	161,624	3,403,817	152,426	3,150,645
[illegible]	3,498,172	3,713,850	3,404,119	3,592,673
	Lb.		Lb.	
[illegible]	43,899,661	7,978,102	29,475,968	1,526,854
[illegible]	61,483,254	1,113,119	42,130,359	7,939,896
	11,555,916	7,899,010	25,747,654	3,540,429

One interesting feature of the above is the increase shown in silver production, reflecting the increase quota-

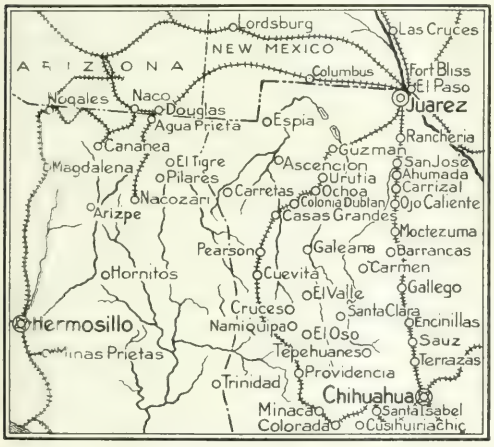
tions for the metal and, to some extent, the opening up of promising northern fields.

STEWART.—A strong vein of a good grade of ore is said to have been struck on the Unicorn group, and ore of high grade has been brought into Stewart from the Glacier Creek property. An open cut, driven 20 ft. on the latter, has exposed rock containing galena and iron sulphide.

VANCOUVER.—During the War the Consolidated Mining & Smelting Co. started the production of zinc on a large scale. Now, with an annual output of 20,000 tons of this metal and the total annual requirements of Canada not exceeding 10,000 tons, some profitable means of disposing of the excess must be found. The Vancouver board of trade promised its assistance in the solution of this problem.

NELSON.—Four of the levels of the Blue Bell mine are being unwatered by a pump just installed and constructed at the Nelson Iron Works from drawings furnished by S. S. Fowler, manager for the New Canadian Metal Co. As soon as this is accomplished the levels will be actively mined. Last year the Blue Bell shipped to the Trail smelter 1249 tons of crude ore and 36 tons of concentrate. To date the property is credited with shipments aggregating 730 tons.

PRINCETON.—The Princeton Mining & Development Co. is proceeding with the work of placing its mine property, situated five miles east of Princeton on the



PART OF SONORA, MEXICO

Great Northern railway, on a permanent shipping basis. There are three full claims on which the vein has been opened by three tunnels, varying in depth from 48 to 480 ft. The vein is reported to have been traced for about 4500 ft. on the surface and the operators assert that they have a large body of concentrating ore averaging 4% in copper and 1 oz. in silver. A three-drill compressor run by steam is in use and another is to be installed to be run by electric power which will be secured from Bonnington Falls by tapping the line to the Copper Mountain mine of the Canada Copper Co.

The annual report of the Canada Copper Co. shows that, with a share capital of $5,441,046 and a bonded indebtedness of $2,920,650 there was a dividend distribution of $622,518 for the year 1919, as compared with $3,025,347 in 1918. The company invested in nineteen properties in British Columbia last year. Both the

A PROSPECTOR IN MEXICO

Greenwood smelter and the Motherlode mine have been dismantled. On construction at the Copper Mountain mine and the concentrating mill at Allenby $1,112,000 was expended. Work on the mill and the railway to the mine is making good headway. It was held up by labor trouble, otherwise it is likely that 2000 tons of ore per day now would be coming from the mine. The ore will concentrate to a 25% copper content and the concentrate will be shipped to Trail to be refined.

TRAIL.—An explosion of gas soon after the blast was turned on in re-starting the copper blast-furnace at the Consolidated M. & S. plant caused damage that will delay the starting of the plant for a week or ten days. Ore shipments received during the week ended July 14 totalled 4810 tons, of which 3533 tons came from the Consolidated company's mines. The other shippers were: Blue Bell, Riondel, 123 tons; Electric Point, Washington, 31 tons; Josie, Rossland, 119 tons; Mandy, Le Pas, Manitoba, 822 tons; North Star, Kimberley, 137 tons; and Providence, Greenwood, 35 tons.

ONTARIO

LA ROSE CONSOLIDATED SETS TO RECOVER FOR TAILING FROM CUSTOM ORE.

COBALT.—Announcement is made that an order in council has been passed by the Ontario government, authorizing the opening of timber on the Gillies Limit for prospecting, the date set being July 20. The Gillies Limit lies immediately adjacent to the silver-bearing area of Cobalt, and is regarded as being a fairly promising prospective field. During the second quarter of 1920, the Bailey mill, formerly known as the Northern Customs

Concentrator, earned $50,478. Work was also started on the Bailey mine, and has resulted in adding to the reserve of 20-oz. ore, formerly estimated at 23,000 tons. This ore will be shipped to the mill just as soon as a railway siding can be constructed.

The La Rose Consolidated has entered action against the Mining Corporation of Canada to recover for the value left in tailing from La Rose ore formerly treated in the mill of the Mining Corporation previously operated as a custom plant. The tailing from custom ore treated as well as tailing from ore subsequently treated by the Mining Corporation are all in one common heap which is now being re-treated. The case promises to be decidedly complicated. Production at the McKinley-Darragh is being maintained at from 55,000 to 60,000 oz. of silver monthly. Considerable new ore is being opened, although not at a rate equalling the amount being mined. Negotiations between the Mining Corporation and the Penn-Canadian Mines have terminated unsuccessfully in connection with the proposed purchase of the Penn-Canadian tailing pile of 125,000 tons. The decline in quotations for silver had an important bearing on the failure of the deal. The Canadian Light Railway Construction Co. has announced that 20 miles of the survey for the proposed narrow-gauge railway from Elk Lake to Gowganda has been completed, and that it is now possible to estimate the cost of construction. In order to finance the building of the Elk Lake-Gowganda line as well as a line from Swastika to Larder Lake by way of Kirkland Lake, an endeavor is being made to raise $1,500,000.

Harry Mills, Minister of Mines for Ontario, announces that during the coming winter courses of training for prospectors will be opened at several mining centres in Northern Ontario, including Sudbury, Haileybury, Timmins, Swastika, and some point at the head of the Great Lakes. The courses, which will be free, will last for six weeks, during which instruction will be given by competent geologists as to rock formation and the sampling and testing of ores. The Department will also open an assay-office at Kirkland Lake, where assays of ore will be made at cost.

Porcupine.—The annual report of the Davidson covering the 10-month period from September 1, 1919, to June 30, shows that $144,245 has been expended in development work, the most important item of which was the extension of the west drift at the 500-ft. level which has been driven along the main vein for 615 ft. This orebody is increasing in width and has an average width of 20 ft. over the entire distance. A gold production of $17,069 was obtained from the milling of test runs on development ore. The management proposes to sink a large shaft to cut the orebody at a depth of 1000 ft. In the meantime operations at the mine will be discontinued, pending plans for financing the work on a large scale.

The option held by the Dome Mines on the Dome Extension expires September 15, and the question as to whether it will be exercised or not is expected to be determined by the result of work now being carried on at the 10th level. Diamond-drilling has indicated a large orebody at a vertical depth of 1150 ft. at the boundary line of the two properties having a dip onto the Dome Extension and work is now being undertaken to verify this conclusion. The core from the diamond-drill hole was officially stated to show a gold content of $7.94 for a distance of 93 ft. and $5.16 for an additional distance of 23 ft. The McIntyre has declared an interim dividend of 5%, making the third to be paid this year. The total disbursements of the company amount to $1,985,655 or 55% of the issued capital.

Kirkland Lake.—The main shaft at the Kirkland Lake mine has reached a depth of 900 ft. being 300 ft. deeper than any other workings in the camp. Ore has been proved to occur down to the 700-ft. level. During May the production was valued at $36,236, the mill-heads averaging $12.03. Ore taken from a test-pit six feet deep, sunk on the recently discovered vein on the Wood-Kirkland, is stated to yield high assays and to contain gold tellurides.

MEXICO

A NEW RAILROAD PROJECT.

Sonora.—The demands for increased pay made by the Mexican labor unions in the State of Sonora have been carried to such an extreme, that, according to reports from that State, the Democrata mine at Cananea will close down at the end of the month owing to inability to meet the demands of the union. The Cananea Consolidated Copper Co., the big producer of the district, while not acceding to the demands of the union, will continue operations, pending negotiations with the Mexican government. The Mexican copper producers, in addition to being affected by the present condition of the copper market, are subjected to much heavier expenses than American operators, as, in addition to taxes paid to the Mexican government, an export tax of approximately two cents per pound is levied on copper bullion and a heavy import duty on coal and fuel-oils.

It is reported that a concession has recently been granted by the new Mexican government to railroad promoters of Ajo, Arizona, for the construction of a railroad from the Mexican line in Sonora to San Jorge bay, on the Gulf of California. This proposed railroad will start at Ajo, connecting at Ajo with the line from Gila Bend, which in turn connects with the Southern Pacific. It is understood that a survey of the proposed road will be made in the near future. Many years ago a railroad from Tucson to Port Lobos, on the Gulf of California, was projected by the late Frank Murphy, prominent mining man of Prescott, but it was never constructed. San Jorge, where the new proposed railroad expects to build its terminal, is believed to be a more advantageous point than Port Lobos. Both are situated considerably south of the extreme northern point of the Gulf of California, it being considered inadvisable to attempt to build a terminal farther north on account of the gigantic tides which make the north end of the gulf an unsafe harborage. It is understood that officials of the Calumet & Arizona Mining Co. are interested in the plan.

ARIZONA

Ajo.—Recently a fire occurred in one of the large wells of the New Cornelia Copper Co., which supplies water to the leaching-plant and the town of Ajo. The fire, which was probably caused by defective insulation, broke out near the 700-ft. level, and threatened the loss of the well. In order to avoid a repetition, the company has decided to fireproof the entire well by guniting all the timbered sections.

Kingman.—The production in May of the United Eastern is given as $175,018, the ore averaging $22 per ton.——It is reported that the IXL property, one of the old properties of the district, lying about 14 miles north of Kingman, has opened up rich silver ore.——At the Cycle mines the mill is said to be running smoothly and high saving is being made. The ore which is being milled averages about $12 per ton.

Tucson.—The Arizona-Tucson Copper Co. expects to install additional equipment on its property. The double-compartment shaft has reached a depth of approximately 200 ft. The material in which the shaft is being driven is heavily impregnated with iron and copper, greatly oxidized.

CALIFORNIA

Amador County.—The work of unwatering the Fremont property near Drytown is progressing satisfactorily. Already the Gover shaft has been drained, that shaft being about 1500 ft. deep, and good headway is being made in the Fremont. The latter has a depth of over 3000 ft. and considerable stoping has been done from the various levels. Relay pumps are to be installed on the 1500-ft. level to make short work of lifting the water from the lower levels. Excessive working costs, due to war conditions, caused the Fremont Consolidated Mining Co. to cease operations two years ago. The property comprised four mining claims, covering 4200 ft. on the Mother Lode, and bears a good record as to the size and continuity of its orebodies so far developed. Alex Ross, formerly in charge of the underground operations at the Kennedy mine in Jackson, is superintending the re-opening of the Fremont workings.

Placer County.—The new 10-stamp mill at the Rising Sun mine, a short distance from Colfax, is working steadily on good ore. Indications in the lower levels of the old producer are encouraging. A small vein has been uncovered and this is adding to the mill production.

Sonora.—High-grade gold ore has been encountered in the Jones-Tarantula property at Shawmut, according to advices from the property. The discovery is said to be highly important and opens to development a wide area of new ground. Development of the group has been in progress several years with varying results. Henry T. Gage is understood to be one of the leading owners of the property, which adjoins the noted Shawmut mine.

At the Shawmut property, operated by the Belmont Development Co., of Tonopah, mining is proceeding at full capacity. The mill is running steadily on ore of excellent character and development of new shoots in the lower workings continues to give results. The property is the leader among Tuolumne county producers and one of the premier m nes of the entire Mother Lode.

Yuba County.—Development work at the Horse Shoe mine at Challenge, which is owned by Joe Supple, shipbuilder of Portland, Oregon, has shown such favorable indications that a five-stamp mill will be erected. An outcrop of ore over 200 ft. long has been exposed. A five-stamp mill at the Rose mine has been purchased by the management of the Horse Shoe company and is being transported to this property. Will Beik is superintendent.

IDAHO

Bonner County.—The Clarksfork Copper Co. will sink to the water level, 100 to 150 ft., from a point on the vein where it was intersected by the tunnel. The vein has been followed by a drift for 40 ft. Two shifts will be employed.

Coeur d'Alene.—Directors of the Silver-Standard Mining Co. contemplate an early meeting at which they propose to let a contract for additional tunnel-work on their property in McFarren gulch, south of Osborne. They plan to let 50 ft. of work at a time. It will be done in tunnel No. 3, which will give considerable depth.——The Bullion Mining Co., in the St. Joe district, will build a mill of 100 tons daily capacity. The quantity of ore in sight is sufficient to supply a mill of this capacity for several years.——Ore in a body 6 ft. wide has been disclosed by a diamond-drill in the Nipsic property of the Callahan Zinc-Lead Co. It was reached from the 600-ft. level of the Callahan and can be opened by 400 ft. of cross-cutting. The core of the drill suggests the presence of 2½ ft. of lead-silver ore, 2½ ft. of zinc ore, and the remainder a mixture of lead and zinc.

If the ore widens and improves the Ajax Mining Co. will make provision for sorting and washing the ore as it comes from the shaft. A hoist with capacity to sink 300 ft. has been installed. Ore has continued for the entire 35 ft. the shaft has gone, and is from 6 to 12 in. wide, of better grade than previously found. Fourteen men are employed.——The Cedar Creek Mining Co., at Wallace, shipped a carload of ore to the Bunker Hill smelter which netted a return of 68.9% lead and 9 oz. silver per ton.

The Copper King Mining & Smelting Co. has completed a raise of 200 ft. from the tunnel-level. The raise has been in ore practically from the beginning, with only one wall of the vein in sight; it opens only a small section of the orebody. Hand sorted ore, removed in the course of raising, contained 20 to 48% lead and 10 to 20 oz. silver per ton. The raise has passed through three streaks of high-grade ore. The remainder of the filling is low-grade mill-feed.

MISSOURI

Joplin.—One of the largest companies operating in the Tri-State district is said to have taken leases on land near Galena, at one time the busiest mining town in the district. A deep run of ore is known to exist, and the company has obtained almost 1000 acres. A few years ago zinc ore was found at 485 or 490 ft. in the drilling of a deep well for city water. The report is that the orebody is more than 10 ft. thick, the ore assaying 8% or better in zinc with a trace of lead. Numerous other deep holes in the Galena field show the presence of zinc orebodies at depths considerably lower than has ever been mined in that district.

The program of drilling started by the Webb City &

Carterville Development Co. seven or eight months ago in an effort to find lead or zinc on new leases is continuing. Three drills are at work but, while indications are favorable at one or two places, no real orebody has been found.

MONTANA

Great Falls.—The Anaconda Copper Mining Co. is said to be considering doubling the capacity of its rod and wire-plant. Operations have been conducted practically at capacity at this plant from well along in 1919 up to the present time, and orders are now in excess of the ability to care for them with present manufacturing capacity. The plant calls monthly for a maximum of 8,000,000 lb. of copper. The company has given more than a passing thought to the possibility of the manufacture of brass at Great Falls, where the company has an adequate supply of refined copper and zinc at hand for alloying into brass. Anaconda has been successful thus far in disposing of its electrolytic-zinc output, and the activity of the company in developing its silver-zinc properties would suggest a confidence in better prices.

NEVADA

Mina.—Cross-cut 701, on the seventh level of the Simon silver-lead mine is being driven west in search of the segment of the orebody thrown off by the west fault. Raise 705-A is being driven from the seventh level to the sixth level, 150 ft. above.——At the Simon Contact property a silver-lead-zinc orebody has been drifted on along the 350-ft. level for more than 50 ft. Average samples returned 56.4 oz. silver, 23.6% lead, 22.5% zinc, and $1.60 gold per ton. Indications point to the orebody being the top of a shoot of considerable size.——Contractors engaged in sinking the shaft on the Fagan Consolidated Silver Mines property have completed the first 100 ft. of the work.

OREGON

Gold Hill.—It is reported that the Chisholm group of mercury mines, adjoining the War Eagle property, that has been worked in a crude manner since 1878, will soon change hands and a large Scott furnace will be erected at the works. This mine is equipped with a 12-pipe furnace operating on high-grade ore.——The Force group owned by David Force of Beagle, is likewise equipped with the pipe-type furnace, but recently-developed rich ore warrants the purchase of a large-capacity furnace.

Obituary

Philo Taylor Farnsworth, a widely known mining man of Utah and Nevada, died at his home in Salt Lake City on July 19, following a two-days illness of acute intestinal poisoning. Mr. Farnsworth was born October 15, 1849, at Salt Lake City, of New England parentage. While a young man he saw active service in the Black Hawk war and other Indian wars in the early days. At one time he was mayor of Beaver City, and later represented Beaver county in the Utah territorial legislature. For twenty years Mr. Farnsworth was manager for the Horn Silver Mining Co. near Frisco, Utah. He also served as manager for the Bullion Beck Mining Co. at Eureka, Utah, for about twelve years, and for about the same length of time was manager for the Austin Mining Co. at Austin, Nevada. Besides these properties, he was identified with the Dalton and Lark mines at Bingham and had numerous other mining interests in Utah and Nevada. Mr. Farnsworth was an enthusiastic supporter of education, and donated liberally to the various institutions of learning in the State. Among his donations was the presentation of the Fort Cameron property in Beaver county, which he purchased from the Federal government, to the Mormon Church. This is now the home of Murdock academy. Mr. Farnsworth is survived by a widow and eight children.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

F. L. Bosqui was in San Francisco last week.

James McKeen, of Cherry Creek, Nevada, is here.

Keith Roberts is at 203 Reaper block, Chicago, Illinois.

Percy Williams, of Silverbell, Arizona, is in San Francisco.

H. Brehm has left Bolivia and is now at Greiz, Germany.

John Kiddie and **J. Webster** are visiting the Globe-Miami district.

Robert S. Davis is with the Alvarado M. & M. Co., at Parral, Mexico.

M. Albertson has moved from Turon, Kansas, to Shreveport, Louisiana.

Lyman H. Brooks Jr. has gone to Cooke City, Montana, to examine mines.

Frank L. Sizer has returned from professional duties near Phoenix, Arizona.

F. Le Roi Thurmond has gone from Santa Barbara to Chihuahua, Mexico.

H. E. Queen, of Berkeley, is now with the Candelaria Mines Co., at Candelaria, Nevada.

L. R. Wallace, manager for the Andes Copper Co. at Portrerillos, Chile, has been in Utah.

Charles Butters has returned to Oakland from Mexico, and is now proceeding to New York.

A. E. Drucker, of the Wisconsin School of Mines, has been visiting the Tacoma smelter and refinery.

George W. Lloyd and **Charles J. Worden,** mining engineers, have opened offices at Quincy, California.

Francis Drake has gone from London to Melbourne. He will be in Australia until the end of September.

Roy Hatch has been appointed superintendent of the Arthur plant of the Utah Copper Co. at Garfield.

W. J. Sharwood, metallurgical chemist to the Homestake Mining Co., was in San Francisco during the week.

L. Venn Brown has resumed control as general manager for the King Island Scheelite Co., at Grassy, Melbourne.

M. W. Hayward has returned to Denver from South America, whither he went to examine mines for the American Metal Co., Ltd.

Edwin E. Chase and his son, **R. L. Chase,** of Denver, have gone to the San Juan district of Colorado to examine mines at Ouray, Lake City, and Rico.

James T. Norton, ore-dressing engineer, has been transferred from the station of the U. S. Bureau of Mines at Moscow, Idaho, to the station at Salt Lake City.

N. M. Muir has opened an office for general mining and petroleum work at 425 Flynn Ames building, Muskogee, Oklahoma. He retains his office in the Mills building, San Francisco.

T. A. Janney, superintendent of the Arthur plant of the Utah Copper Co., has been promoted to the position of chief metallurgical engineer in charge of all the company's plants.

H. C. Bellinger has been appointed vice-president of the Chile Copper Co. and will make his headquarters at New York. **Burr Wheeler** succeeds Mr. Bellinger as general manager at Chuquicamata.

At the recent commencement of the University of Pittsburgh, the honorary degree of Doctor of Science was conferred upon **Professor H. H. Stock,** head of the Department of Mining Engineering, University of Illinois.

Charles G. Yale remains in charge of the U. S. Geological Survey's office in San Francisco. An impression to the contrary has been given by a badly worded paragraph in the 'Engineering and Mining Journal'. **J. M. Hill** comes as a welcome associate, not as a successor, to Mr. Yale.

METAL PRICES

San Francisco, July 27

Aluminum dust, cents per pound	65
Antimony, cents per pound	9 00
Copper, electrolytic, cents per pound	19 00
Lead, pig, cents per pound	8 75 –9 75
Platinum, pure, per ounce	$85
Platinum, 10% iridium, per ounce	$118
Quicksilver, per flask of 75 lb	$88
Spelter, cents per pound	9 25
Zinc dust, cents per pound	12 50—15 00

EASTERN METAL MARKET

(By wire from New York)

July 26.—Copper is quiet and steady. Lead is strong and higher. Zinc is dull but easy.

SILVER

Below are given official or ticker quotations, in cents per ounce of silver 999 fine. From April 23, 1918, the United States government paid $1 per ounce for all silver purchased by it, fixing a maximum of $1.01½ on August 15, 1918, and will continue to pay $1 until the quantity specified under the Act is purchased, probably extending over several years. On May 5, 1919, all restrictions on the metal were removed, resulting in fluctuations. During the restricted period, the British government fixed the maximum price five times, the last being on March 25, 1919, on account of the low rate of sterling exchange, but removed all restrictions on May 10. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine) calculated at the normal rate of exchange.

Date	New York cents	London pence
July 20	89.50	52.75
" 21	94.00	55.25
" 22	93.25	55.25
" 23	91.25	54.37
" 24	91.37	54.37
" 25 Sunday		
" 26	95.00	56.62

Average week ending

	Cents	Pence
June 14	86.00	48.02
" 21	87.07	48.73
" 28	91.41	51.69
July 5	89.97	51.68
" 12	92.18	52.66
" 19	91.04	52.91
" 26	92.39	54.77

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101 12	132.77	July	99.62	106.36	....
Feb.	85.79	101 12	131.27	Aug.	100 31	111.35	....
Mch.	88 11	101 12	125.70	Sept.	101.12	113.92	....
Apr.	95 35	101 12	119 56	Oct.	101.12	119.10	....
May	99 50	107 23	102.89	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound

Date	
July 20	19.00
" 21	19.00
" 22	19.00
" 23	19.00
" 24	19.00
" 25 Sunday	
" 26	19.00

Average week ending

June 14	19.00
" 21	19.00
" 28	19.00
July 5	19.00
" 12	19.00
" 19	19.00
" 26	19.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan	23 50	20.43	19 25	July	26.00	20 82	....
Feb.	23.50	17 34	19 05	Aug.	26.00	22.51	....
Mch.	23.50	15 05	18 49	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19 23	Oct.	26.00	21.66	....
May	23.50	15.91	19 05	Nov.	26.00	20.45	....
June	23.50	17.53	19 00	Dec.	26.00	18 55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	
July 20	8.75
" 21	8.85
" 22	9.00
" 23	9.00
" 24	9.00
" 25 Sunday	
" 26	9.00

Average week ending

June 14	8.75
" 21	8.21
" 28	8.15
July 5	8.39
" 12	8.25
" 19	8.45
" 26	8.93

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5 60	8.65	July	8.03	5.53	....
Feb.	7.07	5.13	8.88	Aug.	8.05	5 78	....
Mch.	7.26	5.24	9.22	Sept.	8.05	6 02	....
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.88	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6 90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93 00	70.11	....
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	....
Mch.	85 00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91 00	71.83	48 33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	
July 20	8.30
" 21	8.25
" 22	8.22
" 23	8.20
" 24	8.20
" 25 Sunday	
" 26	8.15

Average week ending

June 14	8.00
" 21	7.79
" 28	7.85
July 5	8.04
" 12	8.15
" 19	8.31
" 26	8.22

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9 56	July	8.72	7.78	....
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	....
Mch.	7.67	6.53	8 93	Sept.	9.58	7.57	....
Apr.	7 04	6.49	8 76	Oct.	9 11	7.32	....
May	7.92	6.43	8.07	Nov.	8 75	8.12	....
June	7.92	6.91	7.58	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	
June 29	85 00
July 6	90 00
July 13	85.00
" 20	90 00
" 27	48.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128 06	103 75	89 00	July	120.00	100.00	. . .
Feb.	118 00	90 00	81 00	Aug.	120.00	103 00	. . .
Mch.	112 00	72 80	87 00	Sept.	120.00	102 60	. . .
Apr.	115 00	73 12	100 00	Oct.	120 00	86 00	. . .
May	110 00	84 80	87 00	Nov.	120.00	78 00	. . .
June	112 00	94.40	85.00	Dec.	115 00	95 00	. . .

THE RAILROADS

Railroad operating results reported by the Commerce Commission for the first five months of this year indicate the carriers would have earned in the period, with the 19½% increased revenue asked in the present rate case, slightly less than the pro rata share of the $1,236,000,000 necessary to show 6% return on property investment. This in spite of the fact that several adverse factors contributed to make the results in that period unsatisfactory.

Estimates made public by the Commerce Commission show that the railroads in the first five months of this year had a total operating revenue of $1,781,063,569 and expenses of $1,631,655,489. Net operating income was $47,923,347. If this revenue had been 19½% greater, as is designed in the revision of rates suggested to the Commission, net operating income would have been increased by about $357,000,000, bringing it to $405,000,000 for the five months.

In the first five months of the year railroads normally, as shown by the test-period, earn 35% of the total year's operating income. On this basis a net operating income in the first five months of $405,000,000 would indicate net operating income for the year of $1,157,000,000, only $79,000,000 short of the amount necessary to show 6% return for the year. The property-investment accounts of the railroads aggregated $20,616,000,000 on October 31, 1919. To show a return of 6% on this total, it would be necessary for the railroads to have had operating income of $1,236,000,000.

In view of difficulties under which the railroads were operating during the early part of this year, this showing should be considered excellent. For the first two months they were under government operation. When returned to their owners, rolling stock and road-beds were generally below standard, so that it is understood maintenance expenses for succeeding months were unusually high. Traffic was interrupted by the steel strike, and later by strikes of coal miners, shopmen, and other railroad employees. In addition it has recently been impossible to operate railroads in many parts of the country at maximum efficiency, because freight offered for transportation has been in excess of the capacity of the roads to handle, necessitating priority orders and special handling.

The railroads, it is understood, have no intention of restoring the two-weeks credit extended to many patrons prior to Federal control. In accordance with regulations prescribed recently by the Commerce Commission, railroads authorized their agents, beginning July 1 to allow patrons on their credit lists 48 hours credit, that is, until morning of the second business day following rendering of bills, to settle charges, this privilege being extended for 48 hours additional credit only on the patron filing a bond satisfactory to the treasurer of the railroad.

Before the railroads were taken over by the Government it had been the custom to allow certain patrons, who had filed applications with the railroads and established their responsibility, to delay payment of freight bills two weeks being the generally recognized limit. The Railroad Administration discontinued this practice, and the 'cash credit list' was established. A recent ruling of the Commission restores the practice of extending credit, limiting the time, however, to two days in ordinary cases and four days for those who file bonds to ensure payment.

MONEY AND EXCHANGE

Foreign quotations on July 27 are as follows:

Sterling, dollars:	Cable	3.78½
	Demand	3.80
Francs, cents:	Cable	7.84
	Demand	7.86
Lire, cents:	Demand	5.52
Marks, cents		1.25

Eastern Metal Market

New York, July 21.

All the markets are quiet but strong with prices higher in one or two.

Buying of copper is satisfactory and prices are steady and firm.

The tin market is quiet and transactions are confined to dealers.

The lead market is very strong and prices are advancing.

There is not much activity in zinc but values are firm to higher.

Antimony is unchanged.

IRON AND STEEL

Appraisal of the effect of the 21% advance in railroad wages is not easy in the absence of clear indications of the attitude of the unions. In the steel-trade the more general opinion is that a widespread strike is not likely. The increasing signs of reaction in various industries are cited as having an important bearing.

Steel manufacturers look for some relief from the difficult conditions of many weeks, with the return to work of experienced railroad workers, but it is recognized that improvement will be slow and it is admitted that the accumulations of product are more than have been commonly known.

While the Steel Corporation has only 60% of its tin-plate capacity in operation, independent makers are doing better, the average for the entire industry being put at 75%.

Structural work is falling off sharply. June reports show 90,400 tons booked by fabricators or 50% of the capacity of the country.

COPPER

There is little change in general conditions. Buying is moderate and fairly satisfactory from both domestic and foreign sources, the purchases extending into the fourth quarter in some cases. The large producers are maintaining their prices firmly at 19c., New York, for both Lake and electrolytic copper, with some sales for fourth-quarter delivery made at 19.25c. In the outside market, so-called, small producers and dealers are quoting both grades of copper at 18.75c., New York. While there are no indications of a heavy buying movement, the situation is fairly satisfactory and the volume of business is good.

TIN

This market continues quiet with the only business reported confined to the buying back by London sellers of contracts. This has been the feature and is an event that is infrequent. It takes place usually when the market here is below the cost of tin importations. Because of this situation there have been few London sellers and the market has been consequently quiet with demand for spot and other positions small. Consumers continue to remain uninterested. Sales on the New York Metal Exchange have been light also. Spot Straits yesterday was quoted in New York at $49.50, with £288 per ton the value in London. Arrivals thus for this month have been 2365 tons, of which 720 tons is credited to Pacific ports. The quantity afloat is 5700 tons.

LEAD

Pronounced strength characterizes the market. This is due to an intensification of the underlying conditions that have prevailed for two or three weeks. There continues to be a deficiency in supply of the metal and consumption is exceedingly heavy. Production does not increase enough to overtake demand and transportation troubles have been and are still a factor. The quotations of the American Smelting & Refining Co. of 7.75c., St. Louis, or 8c., New York, are nominal, as that company is not selling. We quote the outside market as 8.50c., St. Louis, or 8.75c., New York, with prompt metal actually sold as high as 9.12½c., New York, and still offered at 9.25c. For prompt shipment from the West the metal has sold at an equivalent of 8.90c. New York. Import lead has been offered at 8.62½c., duty paid, which would indicate that such metal is likely to appear despite the belief that the price of the leading interest is kept low to prevent this.

ZINC

There has been little change in conditions. Prices remain steady, to strong, with the tendency upward. There has been a depletion of stocks in the hands of producers and production has been slowed-down recently, which makes for a strong technical position. Most large sellers are disinclined to sell beyond August and are not anxious to buy at present levels, which are not much, if any, in excess of cost. Demand is fair from domestic consumers. We quote the market for prime Western at 7.95c., St. Louis, or 8.30c., New York, for early or July-August delivery, with some sales made into September at this level. There has been a resumption of mining in the West, several mines having been closed about three weeks ago.

ANTIMONY

Conditions are unchanged and wholesale lots for early delivery are quoted at 7.50c., New York, duty paid.

ALUMINUM

The leading interest is quoting 33c., New York, for wholesale lots of virgin metal for early delivery. The same product can be obtained from other sellers at 31.50c., New York.

ORES

Tungsten: There is no activity and the market remains featureless. Quotations are nominally unchanged at $6 per unit in regular 60% concentrate.

Ferro-tungsten is in moderate demand at 80c. to $1.05 per pound of contained tungsten.

Molybdenum: There is no life to this market, with quotations nominal at 65 to 75c. per pound in regular concentrate.

Manganese: Caucasian ore has been offered at 80c. per unit, seaboard, for shipment in September, October, and November. Indian ore has also been offered at the same figure. It is believed that no more than 70 to 75c. per unit, seaboard, would now be paid by users.

Manganese-Iron Alloys: The market is quiet with demand confined largely to small lots for prompt and early delivery. There is one inquiry for 600 tons for delivery in August, September, and October at 200 tons per month. Quotations are firm at $225 for spot and $200 for last-half delivery. The spiegeleisen market is quiet but firm at $75, furnace, with moderate sales for early delivery.

The Antwerp diamond-cutting industry is passing through a depression unequaled since the American financial crisis of 1907. The industry normally employs about 13,000 men. Some 5500 are now without employment, and the industry is working at only about 50% of normal capacity. The chief cause of this depression is the almost complete suspension of orders from the United States. American buyers are usually relied on to take more than half of the Belgian output of cut diamonds. Extraordinary demand for diamonds in the United States following the Armistice has, however, been followed by a reaction.

T. A. RICKARD, - - - - Editor

STATISTICS of gold production in Rhodesia show an eccentricity for the month of May, the value of the output being nearly double that for April, although the quantity of gold produced during the two months was nearly the same. The anomaly is explained by the fact that to the value of the actual May output there was added nearly £200,000—to be exact, $197,043—on account of the gold premium during the period from October 1919 to January 1920. Thus in the three months the premium was about equal to the normal value of a month's output.

ON his return from Pachuca to London, Mr. Alfred James was interviewed by the 'Financial Times'. We note that he reports favorably upon conditions in Mexico. The people are tired of revolutions, he says, and ask only to be left quietly at work. Obregon is described as "firm and able". Mr. James makes a sly dig at us when he says: "Whatever the future of oil in Mexico may be—and the demand is very great while the territory so far proved productive is extremely limited—there can be no doubt that the enterprise of the British mining and other companies who have devoted themselves to the exploitation of Asia, South America, and other oil districts will, before long, be as highly appreciated by the investor generally as it appears now to be by our American cousins." Boy, page Senator Phelan!

AN excellent example of extending the life of a mining enterprise by the acquisition of new property elsewhere is afforded by the Oroville Dredging Company. This started by acquiring and exploiting gold-dredging property at Oroville, California, in 1905. The first company was registered in Maine and was succeeded four years later by an English company, which purchased large dredging areas at Pato and Nechi, in Colombia, two subsidiary companies being organized in 1909 and 1914 respectively. The original American company, controlled in London, is now being liquidated, as the ground at Oroville has been worked out; it paid 37½% on its capital of $3,500,000 up to 1909, and since then its successor has paid 47½% on an equal amount of capital. Oroville Dredging started badly; the ground was purchased on an appraisal made largely by the vendor's engineers and proved to be considerably less profitable than was anticipated; in consequence, the company was over-capitalized. These early blunders have been retrieved, in large part, by the later extension of the company's activities to South America. Last year the Pato earned $29,724 on a capital of £100,000, of which the Oroville company holds £70,000; likewise the Nechi earned £61,995 on a capital of £140,000, half of which is held by Oroville shareholders. The success of this enterprise is shared by Mr. W. A. Prichard, the mining engineer responsible, and Mr. F. W. Baker, the chairman of the three companies.

SECRETARY DANIELS and Secretary Paine obtained valuable information from their inspection of the Chicaloon coal mine in the Matanuska field. So says an official bulletin issued by the Navy Department. What information the publisher of a country newspaper and a very able lawyer could gather between them concerning an extremely difficult phase of coal mining, we leave the reader to conjecture. We are in no doubt as to the value of it. It is not recorded whether the Honorable Josephus was accompanied by a mining engineer, but we note that Mr. Sumner S. Smith has been given charge of coal mining for the Navy under the Alaskan Engineering Commission. Strange as it may seem, we have a respect for the opinion of a mere engineer like Mr. Smith such as we confess to lacking entirely in respect of the Secretary of the Navy—that is, in regard to coal mining, of course.

IN this issue we publish the remainder of the article by Mr. Charles A. Mitke on mine-fires in the South-West. Mr. Mitke has devoted most of his time during recent years to the study of those phases of metal mining that have to do with systematized operations as distinguished from the exploration for, and development of, ore. He is thoroughly informed on nearly every mine-fire in Arizona, not only in regard to its origin and cause but as to the measures taken to isolate or extinguish it. The causes of 35 active fires in the copper mines of the South-West are given by Mr. Mitke as follows: careless use of candles, 3; defective electric wiring, 5; friction from movement of sulphide orebodies, 11; incendiarism, 15; and unknown, 1. The efforts of mining companies today are directed primarily toward preventing, rather than fighting, fires. Modern equipment and organized plans for inspection and immediate action in emergency make an unexpected fire of any size almost impossible. Even should a small blaze start, it could gain no headway. In June 1917,

electricians were lowering a lead armored electric cable in the Granite Mountain shaft of the North Butte Mining Company. The tackle broke, and the cable fell in such a way as to tear off much of the armor and expose the highly inflammable insulation beneath. A mine foreman, engaged in recovering the cable, accidentally lighted this insulation with his carbide lamp and the shaft-timbers burst into flames. The workings were filled with smoke and 171 miners were suffocated. This catastrophe served as a lesson to operators throughout the West and encouraged the adoption of sprinkler systems, concreted shafts, 'gunited' stations, fire-doors, bulkheads, and similar precautions. A few weeks ago a timbered well that supplies water to the New Cornelia company's leaching-plant at Ajo was threatened by a fire near the 700-ft. level. We are informed that the timbers will be coated with 'gunite' (sand and cement applied with a pneumatic gun) to avoid a second fire, which might be more disastrous. One of the most important requirements is an adequate system of mechanical ventilation. Not only does positive uniform ventilation minimize the danger of loss of life, and reduce the cost of fighting fires, but it may in a large measure prevent fires in sulphide orebodies by keeping the temperature below that necessary to start combustion. Mr. Mitke's articles may well be read by every mine manager and superintendent, for fire is no more a respecter of mines than of buildings.

WE take pleasure in publishing another letter from Mr. Charles Butters, in advocacy of the greater use of silver coin. Whereas we think there is little chance of supplanting the use of checks and other forms of paper money in the United States by the circulation of silver dollars in ordinary business transactions, we do appreciate the conditions that may render such a proposal feasible in Mexico. There, at the present time, the currency consists mainly of American silver coin and *billembiqués,* or promissory notes, besides the various kinds of fiat money printed by successive presidents and *de facto* governments, alive and dead. The Mexican naturally looks askance at all forms of paper currency, the value of which is doubtful and subject to discount. In his small dealings he needs silver, of which in coined form there is not enough to go around. What more reasonable than to coin the silver metal produced by the mines of Mexico and put the product into immediate circulation? In this country we would not care to carry or hold more than five silver dollars at a time; they are clumsy; we prefer to convert them into bank-notes, the value of which is incontrovertible—at least for ordinary purposes. The Mexican peon is not unwilling to load himself with heavy coins, preferring to put them under the hearth or in some other safe hole rather than exchange them for doubtful paper. If the silver of the mines—for instance those owned by Americans, like Mr. Butters—is coined by the Mexican government, then the mine-owners, instead of exporting bullion at considerable expense and subject to sundry duties at both ends, could use their Mexican dollars to buy Mexican products for export to the United States. For example, they might buy carloads of the highly nutritious chick-pea, *garbanzo,* which General Obregon is exploiting so successfully in Sonora. They might buy other products, such as *henequen* and *gayule,* hides and wool, from other deserving Mexican citizens, many of whom, most properly, on account of their unusual intelligence, are now officers of the Government. It seems to us that the Butters idea is commendable for many reasons, the chief of which we mention last, namely, it would take Mexican silver off the American market by putting it to a beneficent domestic use.

GEORGE WHITE, the new chairman of the Democratic National Committee, is interesting to miners because soon after graduating from Princeton he made the adventurous journey to the Klondike during the rush of 1898 and remained there three years. He was one of the lucky men who came away with a fortune—nothing big, but enough to start him in successful oil speculation. It is said, in the 'New York Times', that he gave a talk on his experience as a gold-miner before a church club at Washington and in the course of his description he told his hearers about digging 72 ft. through frozen ground to reach the gold, which was separated from the gravel by washing with water. Whereupon Mr. James M. Cox, then a member of Congress from Ohio, twitted him for asking intelligent people "to believe that where the ground is frozen 72 ft., running water is found". Many of our readers know how to explain the apparent discrepancy. The freezing of the ground is due, not to the cold of the preceding winter, but to the cumulative effect of a long period of excessive cold, namely, the Glacial period. The ground is frozen three hundred feet deep, or as deeply as the water percolates from the surface. The gold-bearing gravel used to be thawed by wood-fires, later by steam, and now by unheated water, as described in our issue of March 13, 1920. After the gravel has been brought to surface, mainly during the long winter, it is washed in summer, when for three months, or slightly more, the air is as warm in the Klondike as in Idaho or Oregon. Running water is plentiful, even if it runs over frozen ground, for the bedrock is in the grip of a primeval frost and only the surface surrenders to the summer sun.

Geologic Fallacies

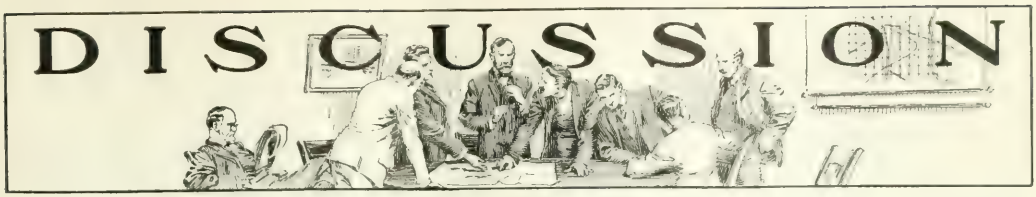
Speaking of real mines, we have been favored with a report on one owned by the Sulphide Mining Company, near Chelan, in Washington. The description has been written by the secretary and treasurer of the company, who judging by his name and by his literary style is of Scandinavian origin. His conclusion is that "from all indications here in time to come will be one of the greatest mines of the United States". That time may come, if the physical forces at work in the crust of the earth succeed in concentrating valuable metals with sufficient intensity at this particular spot, but it is more than probable that we shall be "ancients of the earth and in the

morning of the times" when that happy event supervenes; our Recent period will seem Algonkian to the descendants of the deluded mortals who will have bought Sulphide Company stock. The little prospectus is a good example of meretricious statement. For example, the ore assays 0.3% in copper, representing $1.20 per ton; 9% in lead, equal to $9 per ton; 16.7 oz. silver, worth $16.70; and "15 hundredths per cent" in gold, equivalent to $3.10, making a total of $30 per ton. Of course, he means 0.15 of an ounce of gold, but that is a negligible error compared to the adding of the assay-values of a number of metals, the presence of which may prove metallurgically conflicting. He adds: "It will be noticed that I did not have this sample [he estimates the value of the vein from the assaying of one sample] assayed for zinc, and there is no doubt that there was considerable zinc in the same." The suggestion that the money to be made from the exploitation of an ore is measurable by adding the nominal value of each of the metals it may contain is a fallacy that has been told "to the marines" and to other supposedly gullible people from time immemorial. He obtains a poorer assay from a sample taken 400 feet higher on the surface of the mountain and thereupon concludes: "This, in my opinion, demonstrates that the deeper one comes on the ledge the richer the ore will be." Another worm-eaten fallacy; as if the finding of $5 ore on the top of a mountain and of $15 ore at the surface a thousand feet lower proved that the ore became trebled in richness if followed to a depth of 1000 feet below the surface. All the experience of mining, not to mention the knowledge of the ways in which outcrops are enriched in places, contradicts the inference of the simpleton. The conditions affecting surficial enrichment are measurable usually not from a former imaginary horizontal surface but from the surface of today. Another sapient observation made by our Scandinavian pseudo-geologist is as follows: "There have been tremendous forces at work which could not develop from only a few hundred feet below the surface, but have issued out of depths thousands of feet below the surface, and therefore these ledges will not work out, but go to unknown depths; and no one needs to be afraid that the ledge or ledges will be lost and not found in driving a tunnel at a great depth." Tell that to the suckers; it has been told them so often, they may believe it! As if the continuity of a fracture in granite ensured the persistence of the ore with which it is filled at the surface or near it; or as if the deep-seated origin of the geologic forces that formed the fracture made certain that it would reach to great depth. A river does not widen toward its source nor does a crack enlarge in approaching the place of its origin. If these foolish notions, long ago exploded, concerning veins were true, we would save time and energy by sinking a mile forthwith, leaving the shallow zone to the timid technicians who still think it best to be guided by observed facts and logical induction therefrom. But the best—or the worst, if you will—is yet to come. On the top of the "ledge", the Scandinavian and another of the same ilk, judging by his name, found "all slag, showing the tremendous heat and the forces that have been working". The vein was capped, so they say, with geologic slag, which apparently had been cooled by the snows of today, for mention is made of the fact that "the lower expanse is all covered with snow". Another inference is made: "No minerals have been discovered in this ledge, and I think for the reason that a certain depth has to be reached before minerals appear." What then, have we here an undifferentiated magma! But why should it cap a vein containing no minerals; is this according to Hoyle or Kemp, or even in accordance with U. S. mining regulations? A vein without minerals is as rare, if not as self-contradictory, as a tree without wood or a politician without talk. So, it appears, if a vein contain several kinds of metallic minerals, they prove its potentiality of wealth in depth, at Chelan, Washington, no matter how much they may interfere with the extraction of the more valuable of the metals. "But suppose", says our pseudo-geologist from the land of the vikings, "that minerals are found in this ledge on a depth from 50 to 100 feet and then down, what an unlimited quantity of ore is here in store." Supposing, supposing—well if a pair of barnyard fowls can produce eight chickens, and the eight chickens proceed to business like their parents, then 64 more chickens will appear, and if the 64 get busy, why, there will be a whole lot of chickens, and so *ad infinitum*. After all, 'minerals' do not make a mine and even a 'ledge' is not a treasury. As Bossuet said, the greatest aberration of the mind consists in believing a thing because it is desirable.

The Salting of Mines

In our issue of July 24 we gave our readers a humorous article on a phase of fraud in mining transactions written by one who is a kindly spectator of what the newspaper reporter calls the mining 'game'. Fiction, even when funny, is not stranger than fact; indeed to be funny it must be linked with fact sufficiently to include an element of probability. The doings described by Mr. Hutchinson have their parallel in real life. We are reminded of the description of an elaborate piece of salting recounted by Mr. Walter McDermott in a paper read before the Institution of Mining and Metallurgy in London in 1894. Mr. McDermott is an engineer of such successful experience and proved sagacity that he could confess himself to have been beaten once by a curious combination of circumstances favorable to a particularly systematic and ingenious scheme of salting. An English engineer brought a series of average samples and half a ton of average ore from a silver mine in the West to Mr. McDermott, who was then living in New York. The samples assayed well and the ore proved docile to ordinary treatment, so the engineer's report was a glowing one. However, for financial reasons, the deal in London fell through. A year later the owner of the mine came direct to Mr. McDermott, who took an option for an English company subject to an examination. Before doing so Mr. McDermott obtained a report from an engineer in the West, confirming the owner's statements. In addition, he received a statement from two other

Western engineers stating that the mine would prove valuable if the ore were milled on the ground instead of being selected for shipment to the smelters. Thereupon he himself went to the mine and sampled it carefully, taking more than half a ton of samples, in sacks that were sealed in the mine by wire through and around the necks, and held by a special lead seal. It was a question whether the full width, six feet, of the lode was rich enough to be milled successfully on a large scale, or whether only a small part of it could be treated profitably on a small scale. In addition to his 25 average samples, he took seven full-sack samples from different parts of the mine, each of these consisting of large lumps of the poorer ore without any fine stuff, the idea being that they would be immune from salting because they could be cleaned easily, so that any 'salt', in a fine or a liquid state, could be removed before assaying. In an evil moment he had to change his program, for his clients pressed him for a preliminary report, whereupon he decided to crush five of his seven bulk-samples at a local sampling-works. He took the usual precaution of cleaning the crusher and rolls himself, dusting the lumps beforehand, as well as quartering the pulp himself and taking samples in duplicate. One set he handed to a local assayer, whom he knew to be interested and whom he could not trust unchecked. The second set of samples he kept in a valise in his own bedroom, but, as was ascertained later, the assayer was in collusion with the vendors, the entire mining camp was involved in a conspiracy six years old, and somebody managed to enter his room and doctor his check-samples. He still had two, which were sent to New York, but, as bad luck would have it, he was delayed by other business in returning thither and the samples arriving before he did they were crushed and assayed by his assistant in New York without taking the precaution to clean the lumps. So this check proved unavailing. Into each sack was introduced a dose of finely divided silver such as is obtained from leaching plants using copper-plate precipitation. As a matter of fact, the lump samples contained naturally only two to three ounces of silver per ton, but when 'doctored' or 'fixed' they assayed 20 to 30 ounces. The smaller samples of crushed ore were 'got at' afterward. In each one Mr. McDermott found, by panning and the use of a microscope, particles of fine metallic silver such as did not exist in the mineral itself. This sinister fact he discovered in the course of milling tests, and it raised suspicion sufficient to cause him to endeavor to re-sample the mine, but again the force of circumstances beyond his control and the skillful actions of the gang at the mine sufficed to defeat his purpose. To this unfortunate result his own clients contributed by their anxiety to consummate the deal, refusing to consider the chance of error in view of the previous good reports and the insistence of the vendors upon a prompt decision. Shortly after the purchase had been made he re-sampled the mine, the first assays disclosed the fraud, and he informed his clients by cablegram that they had been deceived. He proceeded to bring the matter home to the perpetrators. After four years of hard work he was able to get a sweeping judgment against the vendors. It was disclosed that the English engineer, who made the first report, had not sealed his sacks; he had tied them with a string and had crushed his samples at the local mill before shipment to New York. The gang had been able to empty his sacks and fill them with selected ore. Unfortunately these samples, after being assayed in New York, were thrown away in due course, but one sealed bottle containing a mixed average of the English engineer's samples was found and upon examination it proved to be free from any metallic silver. This served as evidence in the trial of the case. An American engineer, who took small samples and sealed them with the end of his penknife, took the samples himself to the express company's office at the nearest railway station, but the agent was persuaded to let the vendors have a look at the samples. They opened the sacks, changed the contents, and re-sealed the packages, using a penknife as the expert had done. The more experienced Western engineer had taken his samples carefully, quartered them in the mine himself, and sealed them in sacks, using a seal bearing his own initial. He also delivered them to the express company's agent in person and therefore felt safe. At midnight the agent and two of the vendor's gang set to work. To avoid breaking the seals, they opened the sacks at the bottom, at the seam, and re-sewed them neatly after substituting a grade of ore more satisfactory for expediting a sale. As Mr. McDermott remarks: "A sack that has the sewing of the join inside, and is sealed at the mouth, cannot be opened at the bottom and re-sewed with absolute impunity; but the opening need not be large, and with neat work, and the big chances of the expert having absolute confidence in the express company or post-office after he has personally delivered his samples, the business can be done." It was, in this case. Moreover the vendor's representative had the foresight to take a copy of the seal on the sacks and had one made for himself. The story is worth re-telling, if only to show how even many precautions will sometimes fail to prevent or to detect 'salting' until it is too late. The use of a magnifying glass to examine the ore is an excellent precaution. Mr. McDermott relates how, when examining an alleged silver prospect in South Dakota, he detected particles of silver to which traces of native copper were attached. On questioning his guide, he found that he had worked in the Lake Superior mines. That sufficed, for the association of native silver and native copper is almost unknown save on the Keweenaw peninsula. The only absolute protection against salting is to be alone at all stages of the work or else to be accompanied by one's own assistants. When the engineer has to go in a hurry to examine a mine offered for sale on a short option, he may have to accept the aid of people in the mine. Then he is in danger. Clients are often to blame for their insistence upon a hasty decision and for their refusal to allow the engineer to adopt the necessary precautions, chiefly plenty of time and reliable assistance. Two sayings should be written, like an electric safety-test warning, on every engineer's notebook and operator's check-book: '*Caveat Emptor*' and 'It is better to be sure than sorry'.



Concerning Silver

The Editor:

Sir—Thank you for your kind notice of my letter, in your issue of July 3, concerning silver. Criticism of any kind is always helpful and enlightening if one only listens carefully enough to the other man's view.

I note your remark that for the silver miner to pay his obligations in his product or silver money "is a pious idea, but we anticipate that those receiving silver dollars would deposit them in the bank, preferring to use checks or Federal Reserve bank-notes". I want to thank you very much indeed for these few lines, because they show me, first, that I had failed to make my argument clear for the silver miner, and, second, that even if the receiver of the silver did not use it but once and then deposited it as mentioned, our object would still have been attained, in part at least.

The silver miner is concerned in the primary marketing of his silver. If the silver is marketed in bars, it can be sold and re-sold, and is a constant menace to the market until it reaches some final manufactured form—the more expensive the form of manufacture the better. Once manufactured into silver salts, jewelry, or plate, it is well off the market, at least for a time. In bangles or anklets on an East Indian woman, where a lot of it goes, it is fairly sure that, for the present at least, it won't bother. With these markets supplied, if the miner goes to the Mint and sells there for the market-price, and receives silver coin in payment, he has put his product into a manufactured form and it takes a price of $1.29 per ounce for dollars and $1.38 for subsidiary coin before that silver can come back on his market for re-sale. In that way the miner has accomplished his object of enlarging his market when the price is down, and has reduced the supply to other users.

What brings down the price is trying to sell where there is no demand. When the silver miner sees a falling demand, he should immediately sell his product to the Mint at any market-price and get his output put into coin. When there, it is safely locked up to at least coinage-value. When he pays this out and it goes into circulation the miner has accomplished his object. What is done with it afterward does not interest him so much. If it is carried around and used and gradually wasted by attrition, so much less silver. If it is put in a bank and the banker issues a paper note against it, still the silver producer is satisfied. If the banker can issue two or more notes against it, the banker is satisfied and the miner did him a kindly turn by giving him a basis for the multiplication of credit, and for the man who wants to borrow there is money and credit where it did not exist before. So it seems to me that the miner, when he coins his silver for his own protection, is in the position of the man who made two blades of grass grow where only one grew before, and I believe such a man is highly respected and looked up to as a public benefactor. If our paternal and non-profit-making Mint buys the silver for, say, 90c. per ounce and coins it into silver at anywhere between $1.29 and $1.38, the silver miner, in addition to all the other benefits he has bestowed, has incidentally given the public about 35 to 40c. per ounce on his output, which is at least twice as much profit as he himself has received. The public gets this because the Government has a monopoly on coinage; which all goes to show what happens when the silver miner goes to the Mint with his silver, or what ought to happen.

Now I will tell you just what happens right now, because it happened to me. You go to the Mint with your fine bars and you ask them to coin them at the market price. The reply is, "Yes, but we pay you in gold. We are not letting any silver out at present. We want the silver to get back our reserve." It is a curious attitude. In other words, our policy at the present time is to give gold for silver. The reason may interest the silver miner. The Treasury may think that silver is cheaper now than it will be in the future, otherwise they ought to be willing to pay out silver.

It is to the interest of the silver miner that every means should be taken to lengthen the time of filling the Government reserve, and that can only be done by reducing the amount of silver going into the reserve and increasing the amount going into circulation.

If any reader can tell me on what grounds the Mint can insist on paying for silver deposits in gold, when the depositor of bullion asks for silver, I shall be very glad to learn.

CHAS. BUTTERS.

Oakland, California, July 20.

The Bunker Hill Enterprise

The Editor:

Sir—The statistical summary of the operations of the Bunker Hill & Sullivan Mining & Concentrating Co., given in your issue of May 15, is interesting and valuable; it indicates the great increase in costs that obtain in mining and concentrating ore as compared with a few years ago. This subject is of much interest to me owing to having had occasion recently to review the costs of a

large number of mines situated in Mexico, in which the operating costs have increased from 40 to 100% over those obtaining in 1912.

In making some notes on the table prepared for you of the Bunker Hill costs, I tabulated them for the years since the production passed 300,000 tons per annum, the figures being approximately as follows:

	1904-1911	1911-1915	1916-1917	1918-1919	1919
Stoping	$1.45	$1.68	$2.07	$2.45	$2.58
Tramming	0.07	0.06	0.06	0.08	0.08
Concentrating	0.31	0.40	0.58	0.74	0.81
Shipping	0.05	0.02	0.03	0.05	0.06
Superintendence	0.08	0.16	0.16	0.48	0.57
Legal	0.01	0.09	0.06	0.11	0.02
Contingent	0.05	0.06	0.06	0.07	0.13
Total	2.00	2.50	3.00	4.00	4.25
Increase, per cent		25	50	100	112

There was a steady increase in the cost of stoping, the cost for 1919 being approximately 80% greater than those for the period 1904-1911. Wages and supplies enter very largely into this. I suspect that the price of power had not been increased to any great extent during this period, and hence stoping costs do not reflect the increase that would have applied had the property been using other than hydro-electric power, and therefore the peak for high price for stoping may not have yet been reached. The cost of tramming has suffered almost no change, which might be explained by the same reason as that mentioned for stoping. Concentration shows a maximum increase of 160%, which may have resulted from some extraordinary expenditures in 1919. The most marked increase is in superintendence, amounting to 600%, which would appear to cast a reflection on the good intentions of the present-day workman. In general, the total cost appears to have increased by more than 100% over that for 1904-1911.

Costs in Mexico have increased from 40 to 100% over those of 1912, as noted above. Supplies that are imported from the United States will average probably somewhere between 100 and 150% over those of 1912. Coal and especially fuel-oil obtained in Mexico have not greatly increased, therefore the item of power has not increased in the same proportion as other items. Wages have probably increased 40 to 60% when considering the tendencies produced by several years of revolution.

S. F. Shaw.

Charcas, San Louis Potosi, July 15.

Some Observations on Smelting

The Editor:

Sir—In your issue of July 10, I credited J. H. Klepinger and Peter Thill (or J. H. Klepinger and Archie Wheeler) as being patentees of the process of blowing concentrate and pulverized fuel separately into a reverberatory, whereas I should have credited it to J. H. Klepinger, Milo W. Krejci, and Charles R. Kuzell.

C. W. Tandy

Garfield, Utah, July 16.

[U. S. Pat. 1,160,621 was issued on Nov. 16, 1915, to J. H. Klepinger, M. W. Krejci, and C. R. Kuzell for a process of introducing oxides of zinc, copper, lead, or other oxide ore, flux, and fuel into a reduction chamber while in the form of dust, so as to fuse, reduce, and separate the metals from the slag.

U. S. Pat. 1,164,653 was issued on Dec. 31, 1915, to the same men, for spraying copper-sulphide ore containing iron into a chamber with flux and powdered fuel, the mixture to be ignited, and air supplied after ignition sufficient to oxidize sulphur and iron, slag the iron, and produce copper sulphide; raw material being added to the fused product to counteract any other oxidation.—Editor.]

Ventilation of Mines

Each mine should have its ventilating equipment and system installed by someone thoroughly familiar with the subject. The main fan should be in fireproof housing, equipped for quick reversal of air currents in event of necessity. Air currents should be split underground by a system of doors, overcasts, regulators, etc., in such way that air is quickly removed from the mine after passing through one or two levels, and in the event of a fire in one part, that the fume may be removed without contaminating any other part of the mine. The chief object in ventilating a mine is, however, to bring the moving air to the working face, the most difficult places to ventilate being blind ends. For such places the best results are obtained with small auxiliary fans directly connected to electric motors (1½ to 10 hp.) and forcing 1000 to 5000 cu. ft. per minute at a velocity of 1000 lineal feet per minute to the working place or face. Blower-fans are preferable to the suction type, as they provide rapid movement in addition to removing impure air. Either canvas or iron pipes can be used with blower-fans. Canvas pipes are more convenient and flexible, but iron pipe lasts longer. The last 50 ft. at least should be of canvas for bringing air directly to the face, and for quick removal before blasting and quick replacement after the blast. The most essential feature of metal-mine ventilation is probably that of competent supervision of equipment and practice. Good results cannot be attained if the ventilating system is left without attention, as is the case in many metal mines, nor if left to a mine foreman, who frequently knows little about ventilation. Progressive companies are realizing the value of efficient ventilation at working faces, and in general find the best results are had when ventilation is placed in the hands of one man who devotes all or most of his time to this work. Where this is done the returns in improved safety and health of employees, and in financial return to the company, far outweigh any costs entailed.—U. S. Bureau of Mines.

Owing to the present high price of platinum, there has been a recent great demand for substitutes for it. At one time platinum was used in making incandescent lamps, but in this use it is now almost entirely replaced by tungsten.

A History of Mine-Fires in the South-West—Part II

By CHARLES A. MITKE

From August 1917 until November 1919, the Coronado mine of the Arizona Copper Company suffered from a series of fires, which, unfortunately necessitated numerout shut-downs. All these fires occurred in active top-slice stopes, in which the percentage of the sulphur in the ore was less than 3%.

The Coronado mine extends along a continuous east-west vein, over two miles long. The main haulage-way is on the adit-level, which is the 1100-ft. level in the Coronado mine. The remaining levels are the 500, 600, 700, and 900, which are all in the vein and parallel. The Matilda shaft, extending from the 1100-ft. level to surface (on top of Coronado mountain) is situated one mile west from the portal of the adit. In 1917 nearly all the Coronado stopes were west of the Matilda shaft, between the 700-ft. and 500-ft. levels. The 700, which is the extraction level for all the Coronado stopes, was the only one at that time which extended from the Matilda shaft (through the Coronado stopes and Horseshoe mine) clear to daylight, at the extreme west end of the vein.

During the month of August 1917, and for some time previous, the mine had been idle, owing to a strike in the district. As a protective measure, the company organized patrols, who visited the workings at stated periods during the 24 hours. At midnight, on August 19, the night patrol detected gas on the western end of the 655-ft. level, in the vicinity of the air-shaft, which is about 1500 ft. west of the Matilda shaft. The source of the gas could not be discovered, as there was no smoke. Later, smoke made its appearance on the 700-ft. level, near the air-shaft, and within a short time it came out in such large volume that it filled both the 655-ft. and 700-ft. levels as far east as the Matilda shaft. This was due partly to the fact that the mine was ventilated entirely by natural draft, and during the summer the air-shaft, though caved by earlier top-slice workings, was a slight upcast during part of the day and a strong downcast at other times.

The part of the mine on fire was worked principally by top-slicing, and a large and continuous timbered mat extended over the 500-ft. level for some 1200 ft. The stopes on the west end (at the air-shaft) were top-sliced down as far as the 655-ft. level, whereas those in the east end had only reached the 500-ft. level. Above the timbered mat a large portion of the workings was caved and broken to surface. It was important therefore that the fire should be prevented from reaching the air-shaft, where the upcast air would carry it through the caved ground into the timbered mat beyond and make its extinguishment extremely difficult.

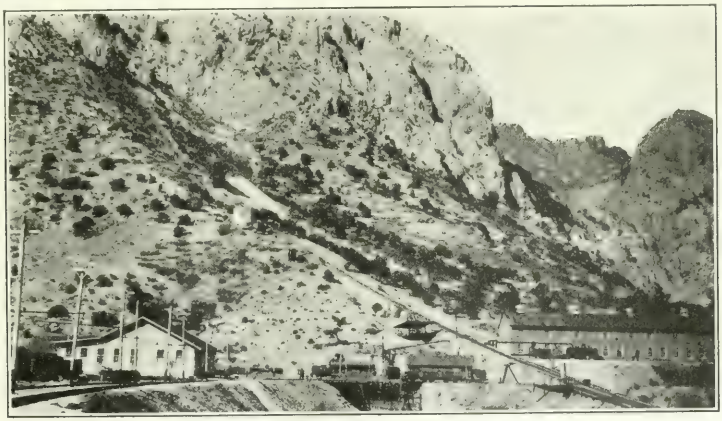


FIG. 6. CORONADO ADIT AND INCLINE

The first efforts to decrease the smoke and gas were made by means of doors, bulkheads, and small fans, in order that an attack might be made on the fire in the neighborhood of the air-shaft, approaching it from the east end of the 700-ft. tunnel, the main object being, if possible, to go up the air-shaft to the level above, and seal the fire that was progressing westward on the 655-ft. level. No attempt was made to reach the air-shaft from the adit on the extreme west end of the 700-ft. tunnel, as this was the natural outlet for the smoke and no electrical power was available at that end. Approach was also impossible from the upper levels, as the fire pre-

vented access on the 655-ft. level, and the air-shaft above this level was caved to surface.

However, before the smoke had been forced back sufficiently to permit of an approach, a cave took place in a stope immediately east of the air-shaft, and the burning rock found its way through chutes and filled that portion of the 700-ft. level beneath the stope. The removal of this caved material was necessary before further progress could be made, and, as it contained considerable pyrite and burning timber, it presented a hazardous undertaking. When water was first turned on, a large amount of steam, dust, and sulphur di-oxide arose from the waste-piles, making it almost impossible for the shovelers to approach. The water-lines had to be kept ten feet ahead of the men so as to flood the caved material before it was cool enough to be shoveled. A considerable amount of spiling and breastboarding had also to be done under the chutes from which the caved material had come.

When the work of getting through on the 700-ft. level was finally completed and the air-shaft reached, it was found that the fire had already progressed to this point and the air-shaft and several adjacent chutes had given way and caused further caving on both the 655 and 700-ft. levels. All hope of attacking the fire from above had then to be abandoned, and it was therefore decided to build bulkheads and flood the ground.

This was an ideal flooding scheme, for the reason that, as stated above, the workings extended along one continuous vein, having parallel drifts on the different levels, and it only required a few bulkheads to complete the reservoir. Two of these were constructed on the 700 (at the east and west ends of the level), one on the 655, and one on the 600 (both at the east end, as on the west the levels ended in solid rock). As all indications led to the belief that the fire had not progresed farther than 55 to 70 ft. above the 700-ft. level, it was apparent that only a comparatively small amount of water would be required. However, in order to make sure that any peaks of flame that might extend into the mat were extinguished, it was decided to raise the water-level about 120 feet.

After the bulkheads were completed, a little over two million gallons was pumped into this underground reservoir. Considerable difficulty was experienced at first in raising the water-level, owing to unforeseen conditions in the vein (through which the tunnel extended) at the point where one of the bulkheads was constructed; nevertheless, the water was finally raised 120 ft. above the 700-ft. level, which thoroughly drenched the lower portion of the timbered mat.

The water was then drained off, the bulkheads removed, and the levels prepared for stoping operations. Subsequent examination and later stoping showed that the fire had been completely extinguished.

Ten months later, on the night of June 17, 1918, three men were gassed while pulling ore from a shrinkage-stope on the 400-ft. level of the Coronado mine, over a quarter of a mile east of the place of the first fire. As a lot of blasting had previously been done, it was thought they had been overcome by powder-smoke. Gas was noticed the following day on the 600-ft. level, about 350 ft. west of the shrinkage-stope mentioned. An investigation was made; although no fire was discovered, nevertheless there was considerable smoke. During the summer, from May to November, the air currents in the Coronado reverse daily and the shafts and small openings through the mat to surface are downcast the greater part of the day, whereas the main adit on the 1100 is an outlet. Bulkheads were therefore put in on the 600-ft. and 700-ft. levels, in order to prevent the gas from going into the lower workings. However, the smoke and gas kept increasing so rapidly that in a short time the workings had to be abandoned.

Blowers were put in operation on the 400, 500, and 700-ft. levels, to force the smoke and gas back and up through the mat and caved workings to surface. The fire was then located in a raise on the 600-ft. level, connecting with one of the top-slice stopes, but before any effective fighting could be done the surrounding ground caved.

As this outbreak had occurred over 100 ft. higher in the mat than the former fire, it was decided not to attempt to re-flood the workings, but to seal the stopes adjacent to the fire, put the remainder of the mine under pressure, and continue operating. The ventilating equipment that was immediately available, although inadequate for the task, was sufficient to force the gas back far enough to allow normal production to be continued, and 11 days after this second fire was discovered, the mine was again in operation.

On August 5, 1918, smoke was discovered in another stope on the 600-ft. level of the Coronado mine, some 150 ft. west of the fire of June 17. This stope was being operated on three shifts by top-slicing for the purpose of carrying it down rapidly in order to sever the timber connection extending through the mat from the point where the fire of June 17 occurred to the live workings beyond. The back of the stope and drift leading into it soon began to settle, which made it absolutely necessary for the men to do a lot of reinforcing and bracing of timbers before an effective attack could be made on the fire. Burning timbers dropped down the chute beneath the stope and set fire to the 655-ft. and 700-ft. levels. The smoke was so thick on these lower levels that the fire could not be extinguished before the ground had caved.

With such a large fire existing in the timbered mat, it was impossible with the inadequate ventilating equipment to continue operating with safety. It was therefore decided to seal the entire mine and admit superheated steam. Pipes were laid and an old boiler-plant on the surface was utilized. The superheated steam was carried into the fire-area on the 600-ft. level in the form of vapor, in order to reach the various peaks of flame that extended from the fire-stopes. This was continued for about six weeks. On November 25, 1918, the mine was re-opened and examined on the 500, 600, and 700-ft.

levels, and while the large fire appeared to be extinguished, a raise on the 500-ft. level, about 300 ft. east, was found to be burning. The entire fire-area was again sealed and steam turned into the 500-ft. level. The finding of the fire above the 500 led to the belief that at the time of the outbreak of June 17, 1918, a number of fires were started in different places in the mine, but owing to caved rock, smoke, and gas, it had been impossible to explore the 500-ft. level before, and consequently this particular fire remained undiscovered until the mine was re-opened on November 25, 1918.

FIG. 6. WEST YANKEE SHAFT, MORENCI

JEROME DISTRICT

Fires have existed in the mines of the United Verde Copper Co. for over 22 years.* These fires were originally caused by friction, due to the caving of orebodies containing a large percentage of sulphur. There have been a number of outbreaks from time to time, necessitating the bulkheading of a large portion of the upper levels.

Various methods of fighting these fires have been tried and the management has finally decided to reclaim the ore in the fire-area by stripping the overburden with steam-shovels.

On January 20, 1917, a cave occurred in the 1407 stope of the small orebody of the United Verde Extension mine. This ore was very heavy and contained a high percentage of copper and sulphur. In a comparatively short time the entire stope became hot and a fire ensued. It was then found necessary to design a temporary ventilating system that would clear the smoke and gas. Raises had to be driven, the cave timbered and cribbed in such a manner as to prevent further movement of ground, while main gangways were established through the stope. After considering the different methods applicable under these circumstances, it was decided to excavate the caved ground by underhand stoping. Considerable patience had to be exercised in training the men to timber the stope thoroughly as the work progressed. After completing the first floor at the top of the cave, and filling with waste, another was started, and this plan was continued until not only the broken ore, but also the loose pyrite scattered around the stope had been removed. The greater the amount of pyrite and rich sulphides removed, the lower the temperature became, until there was a complete absense of gas and the heat had decreased so that working conditions were restored to normal.

In December 1917, a fire at the collar of the Daisy shaft of the same company destroyed several sets of timber. However, hose and water connections were soon available and in a comparatively short time this fire was extinguished. It was taken in time and resulted in only slight damage. Since then the first set below the collar, and connection to the fan on surface, have been made of concrete.

CAUSES OF MINE-FIRES

The usual causes of fires are defective electric wiring, neglected candles, heated bearings, blasting, spontaneous combustion resulting from pyritic orebodies that have caved, and incendiarism.

FIG. 8. UNITED VERDE MINE, SHOWING SURFACE THAT IS NOW BEING STEAM-SHOVELED

Fires in surface-buildings have been the cause of many catastrophes underground. The fire is communicated to the shafts and thence to the workings. In recent years, however, steel head-frames and other fire-proof construction have come into general use and a convenient water

*'Mine-Fire Methods Employed by United Verde Copper Co.' R. E. Tally, A. I. M. E., Bulletin, Sept. 1916.

supply is usually available, so that the possibility of mine-fires from this source has been largely obviated.

During recent years there have been at least 35 active fires in copper mines in the South-West. Twelve of these were in shafts, while the remainder occurred in drifts, raises, and stopes. The causes may be classified as follows:

Candles	3
Defective electric wiring	5
Sulphide stopes	11
Incendiary	15
Unknown causes	1
	35*

Fires in sulphide stopes were the cause of at least 31% of the above. These fires originated from the heat caused by friction in moving or caving ground, containing a high percentage of sulphur. Such fires are extremely dangerous on account of the gas that is given forth. Aside from the distillation products of wood, sulphur di-oxide is always present in large quantity, which adds considerably to the difficulty of fighting a fire.

When stoping is first commenced in an orebody of this character, the workings are just as cool as they are in a body of ore having no sulphur content, but after mining has progressed for some time, should the ground be allowed to settle or cave, the results of friction are indicated by a steadily increasing temperature until the stope becomes so hot that it sets fire to the timbers. These in turn set fire to the sulphur in the ore. The importance of selecting the proper method of mining an orebody of this character cannot be too strongly emphasized. As a general rule, no caving method can be applied, and as this ore is usually very heavy it must be stoped by taking out very small sections and immediately filling with waste. In this way only a limited portion of ground is left open at any one time, thereby minimizing the danger from caving, which is the principal cause of fire in sulphide ores.

Great caution should be exercised in operating stopes by the top-slice method. A fire that has once obtained a good start in the timbers usually forms peaks which extend so far up in the mat as to become inaccessible; and while the lower part of the fire may be extinguished, there is always the danger of these peaks of fire progressing through the caved ground along the top of the mat. For this reason, every mine in which the top-slice method is used should be equipped with mechanical ventilation, and fire-fighting plans fully prepared beforehand, so that should a fire start the section in question may be bratticed off immediately, put under pressure, and an attack made before the fire has an opportunity to get beyond control.

Aside from the active mine-fires described in this paper, there were at least five dormant fires, which were the result of filling old stopes with timber and pyrite before the danger of sulphide fires was appreciated. Some of these required a great deal of development work and considerable expenditure before they were cooled sufficiently to prevent their generating gas, and thereby endangering the live workings.

Many writers have shown reserve in including incendiarism among the causes of mine-fires, but a careful study of the origin of recent fires in the South-West shows that over 40% of them have had this sinister origin. Since this has become a definite cause, it is imperative that the fact be recognized and preparations made accordingly. A few companies have already realized this and have made adequate preparations to prevent such fires, principally by sealing their old workings, locking the exits and entrances to mines, erecting doors at shaft-stations, and resorting to mechanical ventilation in the newer workings. For instance, at one mine, separate water-pipes are laid parallel with the air-pipes, fire-doors are being built to separate the shafts from the workings, and also the different divisions from each other; a large number of bulkheads have been constructed to seal old workings; a system of fire-patrol introduced; helmet crews trained, and complete apparatus and fire-fighting equipment kept on hand. A second mining company, aside from installing a mechanical ventilating system, has adopted further preventive measures, such as placing water-pipes in the shaft, fire-doors to separate the different mines, removal of mule-barns from shaft-stations, and concreting of the main hoisting-shafts. Another large mine has an extensive system of fire-protection, which includes mechanical ventilation, sprays in the shafts, doors at shaft-stations, and a complete code of directions, specifying duties for everyone in the organization.

Other companies have realized the great importance of fire-proofing their main working-shafts (as well as making them downcasts), so as to eliminate the danger of fire in the shaft, and the possibility of any smoke or gas entering the live workings from this source. By making the working-shafts downcast, in the event of a fire underground, the men can then come out to the different shaft-stations into good air, and without fear of the gas overtaking them.

The old method of fighting fires was to make a dash into smoke or gas without any pre-arranged plan, keeping the entire crew in the most excitable condition and doing many things that were extremely hazardous and that really accomplished practically nothing toward extinguishing the fire. At times, helmet men were sent thousands of feet into gaseous atmosphere, when there was but a bare possibility of their ever returning. In one case, two helmet men out of five lost their lives under just such circumstances, without a single thing being accomplished. Another old-time method was to have men rush into gas to build a bulkhead, unprotected by helmets, and work two-minute shifts, then return to fresh air while two other men rushed in and took their places. There are cases on record where it took several days to build a bulkhead in this manner, which can now be con-

*This total does not include the numerous outbreaks in the United Verde mine at Jerome during recent years, nor the inactive fire-areas and dormant fires in other mines in Arizona.

structed within a few hours when mechanical ventilation is used in fire-fighting. In the former case, not only did it take much longer to build the bulkhead, but many men were overcome with gas and had to be rushed to fresh air, while the remainder of the crew were sick and suffered from headache and nausea when going off shift.

In fighting fires in shafts, care should always be taken to see that the *men are first removed to a place of safety, before any water is turned down the shaft.* When the men are out of danger, the most effective method of attacking the fire is to close the iron doors at the collar, and the doors at shaft-stations on the different levels, for the purpose of bringing the ventilation to a stop while water is turned on the fire from sprays placed at regular intervals down the shaft. Merely closing the iron doors at the collar is not sufficient to hold the ventilation in check, as there is always a certain amount of leakage, and in such cases gas has been known to proceed along the main haulage-ways for hundreds of feet from the shaft. When water is turned into a shaft under these circumstances, if there are any men in the mine, in all probability there will be a good many fatalities. One instane of this kind has already occurred in which over 50 men lost their lives. This illustrates the necessity of installing fire-doors at shaft-stations as well as at the collar of the shaft.

One of the serious dangers accompanying the fighting of fires in mines is that of air-blasts, which are caused by caves following the burning of the timbers in raises and stopes. These may be frequent; their intensity depends on the quantity of material and the height of the cave. Great care should be exercised in work around a fire where caves are likely to occur, and frequent instructions should be given to remind the men of the serious results that may follow their being caught in the gas resulting from the air-blast. There are cases recorded where men have received fatal injuries by inhaling these noxious gases, in conjunction with minute particles of burning charcoal, even though not exposed to them for more than two minutes, while, incredible as it may seem, their companions escaped injury by simply holding their breath and walking a distance of ten feet into good air. The fall of rock down a raise, causing a tremendous air-blast, forces the heated and burning charcoal (which appears in the form of fine black dust), along the tunnels or drifts for hundreds of feet. When this combination is inhaled, the hot poisonous gas and dust destroy the tissue of the lungs. These air-blasts are frequently mistaken for explosions of carbon mon-oxide. This is an erroneous idea, as, so far, every case in the South-West has been the result of falling ground.

When exploratory work has to be done long distances through smoke and gas, mechanical ventilation is usually employed to clear the atmosphere as far back as possible. As the workings are being cleared of smoke and gas by means of ventilation, great care is always exercised to prevent the fresh air from stimulating the fire. This is accomplished by the extensive use of bratticing. The brattices are moved ahead as the work of clearing the smoke and gas progresses. When the fire-area is reached, water is turned on through openings in the brattices.

FIG. 9. UNITED VERDE EXTENSION MINE

This method permits the maintenance of a safety-station in the proximity of the fire, so that attacks can be made by men without oxygen apparatus. While helmet-crews are necessary for exploratory purposes, and, in exceptional cases, to complete work in certain places that cannot be ventilated quickly, nevertheless, the larger part of the work is done by men without oxygen apparatus, and therefore a far more rapid attack can be made on the fire.

The work of fire-fighting is frequently rendered extremely hazardous by the caving and air-blasts. In many instances, the warning that precedes these air-blasts is very slight, consisting either of a slight cracking of timbers, falling of cinders, or dropping of small particles of rock. Experience has shown that a man wearing a hel-

met, owing to his encumberances, is not as sensitive to these signals and cannot make his escape as quickly as a man without the apparatus. It is therefore quite an advantage to be able to conduct as much of this dangerous work as possible in good air without the apparatus. Another advantage is that fewer men have been knocked out by smoke and gas as compared with those fighting fires in mines ventilated by natural means.

Still another consideration of great importance is the continuity of air currents in a definite direction, when mechanically controlled, as contrasted with the variable movements of the natural draft, which subject the miners to continual atmospheric changes, depending upon the season of the year and time of day.

The economy of mechanical ventilation is apparent when it is considered that the cost of fighting fires in mines where such systems are used ranges from 10% to 20% of that in mines using only natural ventilation. This has been proved in all the largest mine-fires in the South-West. Furthermore, a considerable number of fires have been extinguished by the use of ventilating systems before the fire had a chance to spread. This would have been impracticable had the ventilation not been controlled by mechanical means, as the smoke and gas would have been carried in every direction by the variable currents of air.

It has been demonstrated in a number of instances that with the use of mechanical ventilation, properly designed and carefully handled during a crisis, a mine in which a fire exists can be kept in continuous operation by controlling all the air that enters and leaves the fire-area, thus obviating long delays, large expenditures, and curtailment of production.

Mining in the Potosi District

A railway connects the city of Potosi with the main line of the Bolivia railway between Uyuni and La Paz. This branch line is 174 km. long and makes connection with the main line at the Rio Mulato junction, which lies 105 km. north of Uyuni and 441 km. south of La Paz. The Condor station on this line, at the point where the railway crosses the divide of the Cordillera de los Frailes, is probably the highest altitude reached by any railway line in the world, being at a height of over 15,800 ft. above sea-level. There are two trains a week between Potosi and Rio Mulato, which make the trip in a little less than 9½ hours. Passengers coming from Antofagasta, after leaving that port at 7:50 p.m. on Tuesday, reach Potosi at 7:34 p.m. on Thursday. The freight traffic of the Potosi district is divided between the Antofagasta and Arica routes, though most of it passes through the former port. The railway line which is being built in from Potosi to Sucre has been completed as far as Betanzos, a distance of about 55 km. Passenger service as far as Betanzos was started several months ago, but this line has not yet begun to carry freight destined for Sucre.

The Potosi district is essentially a mining region, and whatever other industries exist are subordinate to this main interest. The mining industry centres about the famous Cerro de Potosi, although there are less important mines at other points outside the immediate radius of the city of Potosi. Silver and tin are the principal products of the Potosi mines, though copper, lead, antimony, and other minerals are also produced. Exports from the district during 1918 were as follows:

Mineral	Kg.
Tin:	
Barrilla (concentrate)	4,639,530
Bars	582,050
Wolfram	1,990
Silver	22,840
Copper	31,000
Bismuth	18,360

The Cerro de Potosi is a cone-shaped mountain about 2000 ft. high, situated on the outskirts of the city of that name. The Spaniards began to work its rich deposits of silver ore in about 1545, and during the colonial régime the enormous quantities of silver taken out of the Cerro, variously estimated at from $1,000,000,000 to $2,000,000,000, formed the principal basis of the mineral industry of the old viceroyalty of Peru. However, the Spaniards not only ignored the tin and other metals existing in the Cerro, but the inadequate methods used in mining and smelting prevented them from securing the full benefit of their labors, so that the dumps left from their workings still contain an appreciable quantity of metal. During the past few decades there has been a marked revival of mining in the Cerro, the present operators being comparatively new comers.

The most important interests in the Cerro are those belonging to Luis Soux, of French birth, who operates several mines in the Cerro and owns a smelter, the only one in Bolivia, which was built about 25 years ago, and in which he makes bars containing about 95% tin. He also sends out large quantities of tin concentrate (barrilla) and silver ore. About 1000 people are employed in all his workings. The second most important interest in the district belongs to Bebin brothers, also of French origin. These men have recently installed a new concentrating plant, where the tin ores from their mines in the Cerro are prepared for shipment in the form of concentrate. The equipment of this plant, which is the most modern of its kind in Bolivia, is of American manufacture. About five tons of barrilla, which runs from 55 to 60% tin, are turned out per day. Probably 400 employees are on the payrolls of the Bebins. Third in importance are the interests of the Anglo-Bolivian Mining Syndicate, Ltd., which is controlled by the Aramayo Francke Mines, Ltd., with important tin, silver, and bismuth mines in southern Bolivia near Atocha. This company works, among other mines, the old 'Real Socavon', which dates from early colonial times. Of secondary importance are the mining interests of Benavides, Cabrimonte, and Medinaceli.

Numerous small operators work one or two 'galleries' with the aid of a few Indians and sell their ore to the larger miners or to the regular buyers of ore.

Oil-Shales and Their Economic Importance

By MARTIN J. GAVIN, U. S. Bureau of Mines

*The twentieth century has often been spoken of as the age of petroleum, and from many viewpoints it can be justly considered so. Certainly the petroleum industry is one of enormous importance to this country, industrially, financially, and economically. The United States, however, at present producing over 60% of the world's total output of petroleum, is not producing petroleum at a sufficient rate to provide for its own domestic consumption. For several years this country has been importing increasing quantities of crude and partly refined oils from Mexico, and has been drawing heavily on domestic stocks of petroleum. Production in the United States is increasing, but it is not increasing at the same average rate as domestic consumption, nor is it probable that in the future domestic production will increase sufficiently to satisfy the demands of domestic consumption, but on the contrary, in the opinion of those best qualified to know, the peak in the curve of domestic production of crude petroleum will be reached in a comparatively few years, whereas the consumption of petroleum and its products will increase at a continually growing rate. This country, then, must turn, and as the increasing imports from Mexico indicate, is turning, to other sources than the crude petroleum produced in this country to make up the deficit between domestic production and domestic consumption of petroleum and its products.

The chief products of petroleum are motor-fuels, kerosene, fuel-oils, and lubricating oils. Of these, the increasing demand for motor-fuels, or gasoline, is perhaps the greatest, and that of fuel-oils probably next greatest. The ever-growing use of the internal-combustion motor, especially in automobiles and trucks, accounts for the first, and the increasing use of fuel-oil, chiefly for steam-raising purposes, accounts largely for the second. Lubricating oils are, of course, of prime importance, as machinery must be lubricated if it is to operate.

To compensate for the deficit in our supply of petroleum we can expect to draw on the enormous potential supplies of Mexico at an increasing rate, and by the use of new and improved processes of manufacture a greater percentage of the petroleum products for which there is the greatest demand will undoubtedly be obtained from petroleum. The more efficient utilization of these products, as for example, through the development and use of the Diesel engine and the gradual change in the design of our present internal-combustion motors, enabling them to use lower-grade fuels, will perhaps tend to relieve the growing shortage. Hydro-electric power, or electricity otherwise produced, can be expected to take the place, to a certain extent at least, of fuel-oil installations on land. However, all these expedients have their practical limitations, and it is to be expected, therefore, that in the comparatively near future new sources of products similar to those now being derived from oil-well petroleum will have to be developed. As a matter of fact, some are already being developed.

There are possibilities of importance in the development of the production and use of benzol as a motor-fuel and other coal-tar products as Diesel-engine fuels and as substitutes for other petroleum products. There are also important possibilities in the commercial production of alcohol as a motor-fuel. In fact, blends of alcohol, benzol, and petroleum distillates are being marketed in the East at the present time as motor-fuels and are giving satisfaction in use. Taking all these considerations into account, however, it is the opinion of many that the oil-shales of Utah, Colorado, Wyoming, and Nevada, and possibly of other States, are extremely important as new sources of products similar to those now obtained from oil-well petroleum. These States contain enormous deposits of oil-shale, which by proper treatment yield gas, oil, and also, if desired, ammonia, of value as a fertilizer. The oil in many respects is similar to oil-well petroleum and yields products similar to those of petroleum.

Oil-shale has been worked in Scotland and France for upward of sixty years. In the former country the industry has been a successful one from a financial standpoint, especially of late years, although it is passing through a difficult period at present. The industry in France has not been nearly so successful as that in Scotland.

The success of the Scottish shale industry has been brought about partly by the development of cheap processes for treating the shales and the oils produced from them, but mostly by local conditions, such as competition only with high-priced petroleum products, low labor-costs, and the fact that the industry grew up in a densely populated region where a ready market for oil and ammonium products was available. A recent reorganization of the Scottish shale companies, combining them into one organization, is hoped to better the present condition of the industry in Scotland.

Oil-shale contains little or no oil as such, but it contains substances which when the shale is subjected to destructive distillation yield gas, crude oil, and nitrogen-containing compounds, notably ammonia, as well as the other products in small quantity and probably of unimportant value for the most part. Oil-shale as a rule must be mined much as coal is mined, crushed, and heated to a relatively high temperature in closed retorts, which may

*Presented by permission of the Director, U. S. Bureau of Mines, before the 13th Convention of the Utah Academy of Science, April 3, 1920.

operate continuously or intermittently. These steps are necessary to produce gas, crude oil, and ammonia, the last of which is in solution in the water obtained along with the oil.

The ammonia water is then distilled and the released ammonia passed into sulphuric acid, producing ammonium sulphate. The crude oil must be refined, much as petroleum is refined, to produce the various commercial products. The refining of shale-oil is more complex and in all probability more costly than the equivalent refining of petroleum. However, the shale-oils can be refined and can be made to yield many products similar to those produced when petroleum is refined. The oils produced from shale of this country will yield gasoline, burning oils, and paraffin wax, all of which when properly treated will undoubtedly be satisfactory commercial products. Whether the more viscous grades of lubricating oils, such as lubricants for internal-combustion motors, can be produced from shale-oil is doubtful, but it may be possible to do so. Little is known in this country as to the refining of shale-oil at the present time, and this statement can be applied generally to the possibilities and technique of oil-shale operations in the United States.

The development of an oil-shale industry to one of considerable importance in this country will require the expenditure of many millions of dollars and take a period of many years. Such development will require much research and technical study, and will require the services of trained executives and experienced technicians. Nevertheless, when economic conditions become favorable it is reasonable to believe that our oil-shale will be of great value as a source of oils similar to those now derived from petroleum. An idea of what large-scale development of the oil-shale industry involves may be gained from the consideration that to produce one barrel of crude oil from shale, on the average at least one ton of a tough rock must be mined, crushed, heated to a relatively high temperature, and finally the residue, amounting to about 75% of the original weight of the raw shale, must be discarded as valueless. The United States now produces over one million barrels of crude petroleum per day.

Our immense oil-shale deposits practically assure us that, come what may, this country will still have its own sources of petroleum products. We should never have to be wholly dependent on foreign countries in this respect. From another standpoint, the shale is also of great economic importance. The oil-shale, especially of the Rocky Mountain country, occurs in sparsely settled regions. Its development on a large scale means the bringing into these regions of a great number of miners and other laborers, often with their families, who will earn their living and spend their money in the same locality. Millions of dollars must be spent in erecting plants, developing mines, and the like, much of which will be spent in the States where the oil-shale occurs. The refineries will require sulphuric acid and other chemicals and supplies, which logically will be produced as near to the shale as possible, thus bringing in more capital and labor. Transportation facilities will be extended to meet the requirements of the operators, thus benefiting the regions now inadequately supplied in this regard. Prices of petroleum products in the regions contiguous to the shale operations can be expected to be relatively lower than they would be if similar petroleum products had to be shipped in.

It should again be emphasized, however, that development of an oil-shale industry to a scale sufficient to be of so much economic importance, will require much study, time, and money. The oil-shale industry is no business for the man of little experience and small capital. It may be compared with the development of the low-grade copper ores of the West, in that it is a large, low-grade, chemical manufacturing enterprise, requiring capital, time, and trained men. The investor in oil-shale operations should know that he will probably have to wait for a long time for a return on his investment and that returns in all probability will be conservative. In spite of this, the day of the oil-shale industry is coming.

The Color Bar on the Rand

Speaking recently as chairman of the Consolidated Mines Selection Co., Walter McDermott said: "Labor, as always, is the most important item, and it covers two separate difficulties, divided by the color bar. White labor is almost wholly some form of superintendence, and native labor constitutes the manual work on which all operation of the mines depends. There is a sort of common land between the two classes of workers in which native labor has proved itself capable of yielding valuable services; but it is a field of rather shifting boundaries, and the encroachment on it by natives is viewed by white labor with extreme jealousy always, and active opposition if it becomes at all marked. The natives are anxious for the more skilled work which carries higher pay. In the past the 'color bar' has been accepted without very serious question by the natives, but in the last few years constant contact with the effect of white-labor movements—in many of which the natives were sufferers, but gained no benefits—has had a marked educational effect, and colored labor has made progress in organization and in the adoption of the active proceedings which are seen to benefit white labor. In the recent strike of natives, the organizers of trouble adopted regular trade-union methods of picketing and rough handling of 'blacklegs' who tried to work; and they thereby succeeded in promoting temporary uniformity of opinion. I believe the correct technical description of this sort of uniformity among English labor circles is "the solidarity of the proletariat", which is in itself quite a comforting phrase. There is a limit plainly within sight to the wages which can be paid in many mines working now on a small margin, and as the increase by war allowances has become permanent in effect, and as it is accompanied by higher cost of all material, and by additional outlay on the prevention and cure of miner's phthisis, the limit of possible working would have been passed already for some of the poorer mines if the premium on gold had not temporarily moved the boundary line."

The Bunker Hill Enterprise—XI

The Use of Electricity in the Operations of Mine, Mill, and Smelter

By T. A. RICKARD

One of the interesting features of the many and varied industrial operations performed in the mines, mills, and smelter of the Bunker Hill company is the use of electricity for divers purposes.*

Electricity was first applied at the mine in 1893, when an Edison bi-polar 500-volt D.C., 30-hp. hoist was placed in a winze below the Sherman tunnel. In 1897 this hoist was dismantled and the motor was employed to drive a fan for ventilating the Wood stope on the fifth level. Power was supplied to this motor through an Edison 500-volt D.C., 25-kw., generator driven by a 24-in. Pelton water-wheel. In 1896 the Bunker Hill company purchased the Edison three-wire 110-220 volt D.C. lighting system owned by Cheyne Bros. This plant was used to illuminate the town of Wardner; it operated two 20-kw. generators actuated by water-wheels on Milo creek at the lower end of the town. An auxiliary steam-engine had to be used during the dry season. It operated under a heavy expense and as soon as the Bunker Hill company gained possession the water-wheels were discarded in favor of a 2080-volt A.C. transmission line and transformers. The Cheyne brothers, Robert and James, were Scots. The elder was mill superintendent under Victor Clement and the younger was jig-man, becoming foreman later. During the riot of April 29, 1899, James Cheyne was captured by the strikers and shot by them. Robert returned to Scotland and died not long thereafter.

Horses and mules were used for hauling the rock broken in the Kellogg tunnel when it was started. In 1896 electric traction was introduced in the form of two General Electric 500-volt trolley-locomotives, each weighing 4½ tons and each having a drawbar-pull of 1000 lb. The power was provided by a G. E. 50-kw. 550-volt D.C. generator connected by belt to a turbine taking water under a 56-ft. head from the mill-flume. The adit, or 'tunnel', was then 3000 ft. long and these electric locomotives were used in finishing the work. They still remain in use. The first ore was hauled out of the adit on November 9, 1902. Meanwhile another locomotive of the same type had been purchased, making a total locomotive capacity of 13 tons (three locomotives). At the present time the total locomotive capacity available at the mine is about 105 tons, besides 36 tons more at the smelter.

The track of the Kellogg adit has a gradient of 0.25% for half its length and 0.50% for the other half;† it is of 24-in. gauge and has 50-lb. rails. The outer half of the road-bed, where the ground is softened by oxidation and surface drainage, is reinforced with concrete. The ore-train runs at the rate of 6½ miles per hour; it consists of a locomotive and 17 cars, each car when loaded weighing 4.4 tons gross. The locomotive has two G. E. type HM-801, 500-volt, D.C., motors, which can be used in parallel or in series; it weighs 8 tons and has a drawbar-pull of 4000 pounds. The cars are called 'Big Sams', a name given to them by Charlie Moffat, an old-time blacksmith, who supposed that the initial 'S' in the manager's name stood for 'Sam', these big cars having been designed by Mr. Stanly Easton for an increased capacity when he first took charge. They are 6 ft. 6½ in. long and 3 ft. 4½ in. wide, with hopper-bottoms. Each car contains 46.4 cubic feet; as the ore averages 14.3 cu. ft. per ton, the car holds 3.25 tons net. The car itself weighs 2472 lb. On the lower levels a smaller car is used; this contains 34 cu. ft. and weighs 1800 pounds.

On the lower levels, where the work of assembling the ore has to be performed, and where short hauls suffice, it is not practicable to use the trolley system. There the storage-battery locomotive does admirably. It obviates the necessity for bonding the rails and for maintaining a trolley-wire; it is capable of assisting itself if derailed, and, on account of the low voltage used (80 to 100), the maintenance of controllers and motors is much reduced as compared with the 550 volts ordinarily used by the trolley type of locomotive. On the other hand, the employment of the storage-battery for traction in the long main adit is considered inadvisable on account of the excessive battery equipment and the difficulty in placing it above the locomotive where the dimensions of the tunnel are restricted; if the battery is trailed behind the locomotive, the efficiency of the latter is reduced by the lack of weight on the driving-wheels and the necessity for pulling a dead load constantly. In low drifts cluttered with chutes or in places where the timbering is being repaired, men are likely to strike the live wire with their tools; under such conditions it is inconvenient and dangerous to use the trolley system.

The Bunker Hill company was prompted to employ the storage-battery locomotive on the working-levels for the reasons already cited and on account of the danger of transmitting a high voltage, such as is required for a trolley system, along small drifts where ore-chutes and low timbers project into the level. Fatal accidents in other mines, as well as in the Bunker Hill, served as a warning against any attempt to use the trolley below the adit-level.

*For my information I am indebted to Walter C. Clark, electrical engineer for the company.

†Where the grade is ½ of 1% in favor of the load it requires exactly the same power to push the empty train upgrade as it does to bring the loaded train out.

The first storage-battery locomotive was used on March 3, 1913; it weighed 2½ tons and made four miles per hour on a track of 24-in. gauge. It was made by the Jeffrey Manufacturing Co. and was placed on the 11th level. This locomotive was equipped with two sets of batteries, each of 63 cells, of the Edison A-4 type. One set was used on the day-shift and the other by night. These batteries were worn out after four years of continuous service and were replaced (in 1917) by two sets of 63 cells of the G-6 type of Edison battery. The second storage-battery locomotive was put to work in June 1913; it consists of a Westinghouse (Baldwin) 3½-ton machine equipped with 68 A-8 Edison cells and type V-50, 80-volt, motors. This locomotive has a running drawbar-pull of 2000 lb. and a maximum pull with sanded rail of 2300 lb. Its speed is 3½ miles per hour. It replaced a 500-volt trolley locomotive on the 12th level. The third storage-battery locomotive was added on May 11, 1914, for the purpose of hauling tailing and sand for concrete road-work on the main street through the company's domain. The haul was 3250 ft. This locomotive was used in road-building until August 9, 1914, when it was placed on the 13th level for assembling ore. It was a General Electric 4-ton machine equipped with 72 A-8 Edison cells. It has a speed of 3 miles per hour and a drawbar-pull of 2000 pounds.

The fourth storage-battery locomotive was placed on the 14th level upon April 30, 1916; it consisted of a Westinghouse (Baldwin) machine equipped with two V-50‡ motors and 63 A-8 Edison cells; it weighed, with battery, 4½ tons and had a drawbar-pull of 2000 to 2300 pounds.

The fifth locomotive is a General Electric machine, which was placed on the 10th level on April 26, 1918. It has 72 G-6 Edison cells and weighs 2½ tons; it makes four miles per hour and has a drawbar-pull of 800 pounds.

The sixth is a Jeffrey machine of 4½ tons, provided with 72 G-11 Edison cells. It began work in the mine in May 1919.

The storage-batteries arrive in trays, 8 by 36 by 15 inches, there being six to eight cells per tray. A battery-box, containing 72 cells, is placed on top of the locomotive chassis. The trays are taken into the mine on the electric train, lowered on the skip, and then assembled at the shaft-station, where they have remained in use on the level for one or two years before being brought back to surface for a general overhaul and thorough cleaning, previous to being returned to service for two years more.

A battery weighs 1800 lb; it is moved by means of a hoist operated by compressed air. If a suitable platform and track are available, the battery is rolled on and off by aid of castors placed on the battery-box at the mine. It may be added that with the later types of storage-battery locomotive, when only one battery is used for two shifts and the battery is not removed from the chassis for charging, it is customary to mount the battery-box on a swivel base, so that it can be turned at right angles to the chassis for the purpose of exposing the motors and for facility in oiling, inspection, and repairs, without removing the battery.

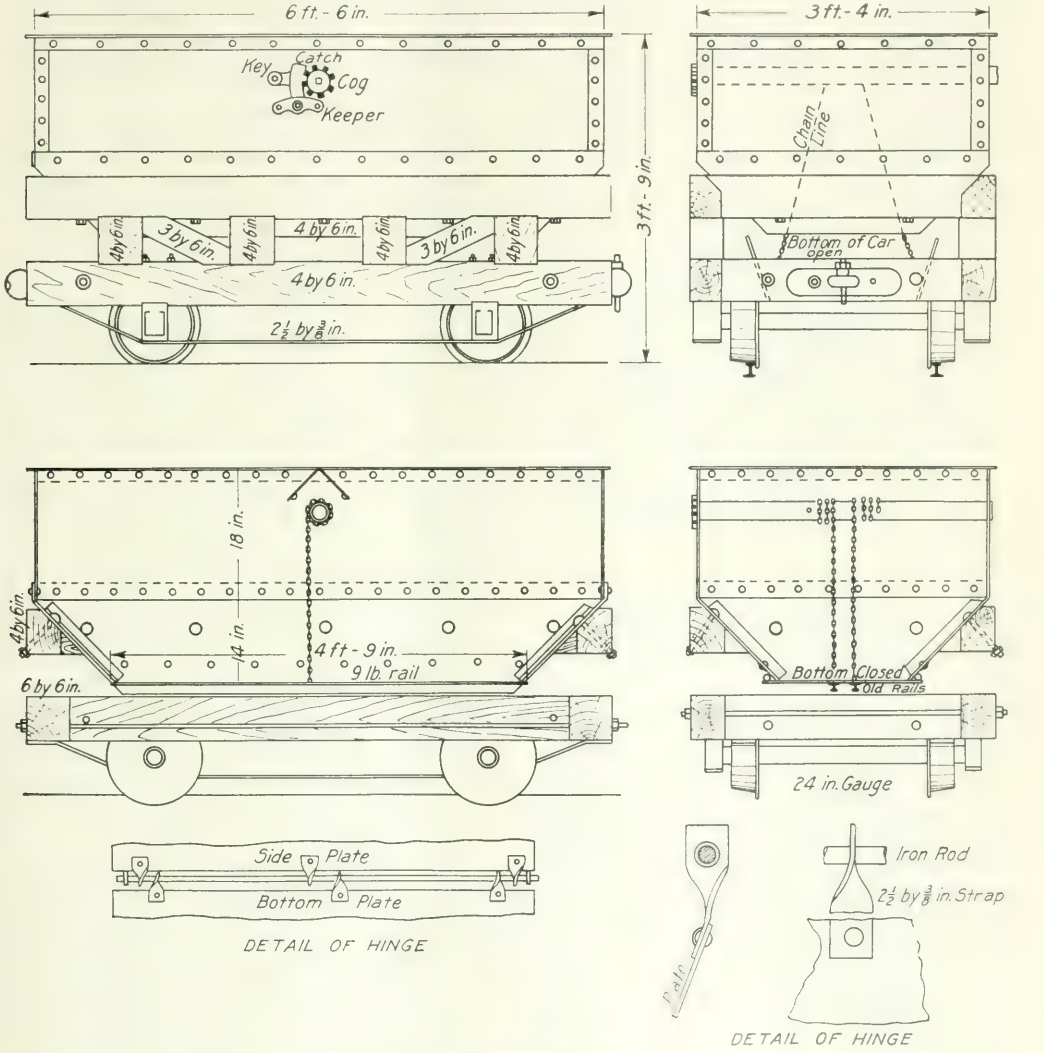
The average life of batteries is four years. As they arrive from the factory they are filled with electrolyte. To charge the battery all that is necessary is to establish contact with the motor-generator set, which is placed centrally in the mine. On each level there is a sub-charging station equipped with variable-resistance and recording ammeters, so that each battery can be charged at the rate required by its storage capacity and internal condition. If a battery is sluggish, an excessive overcharge is given, and, in special cases, even a reverse charge may be given with beneficial effect. When a battery appears sluggish during the shift, a booster-charge may be given at twice the normal rate for a period of 20 to 90 minutes, in order that it may complete the shift without slowing down the train or causing the delay consequent upon the changing of batteries. This booster-charge is given at times when the train is standing idle or the motor-man is otherwise engaged, say, at lunch or attending to the locomotive equipment. The boost is given by increasing the volume, or amperage, of the electric charge to twice its normal rate, this being done by connecting the battery to the charging-station through the rheostat, or resistance-coils, thereby regulating the volume of charging current.

The specific gravity of the electrolyte changes, owing to evaporation of the water it contains, during the charging and discharging of the battery, so that it becomes necessary to add distilled water at regular intervals. Indeed, the healthy condition of the Edison battery is indicated in large measure not by the specific gravity of the electrolyte, as in the old lead cell, but by the amount of water required. If the proportion be excessive, this points to one of two conditions: either a deterioration of the electrolyte, or to excessive duty demanded of the locomotive on account of the bad condition of the track, caused, for example, by falls of rock on the rails, bad joints or curves, and the like. The water used for the batteries is obtained from Barnstead stills sold by Braun-Knecht-Heimann of San Francisco; these stills are heated electrically and have a capacity of a gallon per hour. One still is placed at each charging-station. Water for this purpose must be absolutely pure. For example, at the start use was made of water condensed from the exhaust-steam taken at about 500 ft. from the boilers of the heating system at the motor-barn. This water, of course, contained impurities, including grease, collected from a long and elaborate system of pipes; the result was a slow deterioration of the electrolyte and of the metallic plates in the cells. Thereupon it was decided to erect a still at the motor-barn near the portal of the adit. Water was delivered from this still to the batteries on the lower levels by means of large glass demijohns, which were carefully padded to prevent breakage, but they proved most unsatisfactory on account of the rough handling unavoidable on such a journey. Then water-bags of 5-gal. capacity were substituted, but these also were unsatisfactory on account of the contamination of the canvas and the con-

‡This does not refer to the power, such figures as 'HM-801', 'V-50', and 'A-8' are merely serial numbers of identification as used by the manufacturer.

sequent penetration of mine-dirt into the contents. Moreover, it was found difficult to empty the bags into a suitable container previous to filling the cells. The next step was to place individual stills at each charging-station.

The filling of the cells is done expeditiously by means of a special nozzle equipped with an electric alarm, which loosening the plates and separators to such a degree as to interfere with their proper action, and causing a steady decrease in the efficiency of the battery. A similar result ensues from a careless handling of the cover on the battery or the contact of steel tools over the exposed tops of the cells, thereby occasionally causing short circuits, the



THE 'BIG SAM' CAR

rings as soon as the liquid is at the proper level in the cell. This obviated any need for attempting to look into the cell, a practice that was found to be injurious to the cell itself and also to the men, because an explosive gas is generated and ignited by the open light used in making an examination. Such an explosion, even of a minor kind, results in a bulging of the sides of the cell, thereby flash from which, like the open light during an inspection, ignites the explosive gas. The bulging sides tell the story. Mr. Clark and his assistant, M. J. Bottinelli, tried to rejuvenate batteries that had been in use for some time or had failed to recuperate under the customary treatment, such as a change of electrolyte, over-charging, and reverse charging. In order to accomplish their purpose,

they attempted to cleanse the cells, removing the accumulated sediment by means of agitation by hand, when the cells were only a quarter-full of electrolyte, and changing the electrolyte several times in each cell. When this method proved too laborious and expensive, they devised a mechanical agitator, which consisted of a cable-reel, 5 ft. in diameter, on the periphery of which 36 cells were clamped. As the wheel revolved the electrolyte flowed alternating from one end to the other of the cells, the ends being closed by rubber corks, so as to rinse the cell and wash out the sediment, the origin of which has not been determined. This practice has now been abandoned because the results did not justify the trouble. Instead, when a battery fails to respond to the usual treatment, it is returned to the factory, credit being received on a new set, this credit being based upon the manufacturer's 10-year guarantee. It is fair to remark that any battery subjected to the severe conditions necessarily incidental to work underground, at a distance of 2½ miles from daylight, and not subjected frequently to the careful scrutiny of an experienced technician, is tried severely; it can hardly be expected to have the life normal to conditions on the surface. The Edison Storage Battery Co. maintains a service-station in charge of a competent engineer at Seattle. This engineer, Foster C. Gibson, takes a keen interest in the Bunker Hill operations and makes frequent visits to the mine, to advise and consult with those in charge in regard to the care and treatment of the storage-batteries, so that the most friendly and mutually helpful relations are maintained between the technicians of the two companies.

The electric haulage system of the mine is protected by block-signals operated by hand. The blocks vary in length, the first is a mile long and includes the outer straight portion of the adit, the other blocks are reduced to a minimum length of 300 ft. A 'safety first' sign is prominent at the point where the Tyler track branches from the main line. The noise of the train is magnified by the narrowness of the excavation and the echo from the rocky walls. In timbered ground the noise is considerably less; it is due to the gear-wheels of the locomotive, the friction on the rails, and the rattling of loose doors. The cars are equipped with springs. An empty train is the noisiest. The length of haul is about two miles. The heaviest train ever pulled out of the adit was one recorded on March 31, 1917; it carried 173,150 lb., or about 86½ tons, net. The weight of the entire train, including ore, cars, and locomotive, was 241,650 lb. or over 120 tons. The locomotive weighed 16,300 pounds.

The positive plates of the Edison battery consist of tubes, ¾ in. diameter, of nickel-plated sheet-steel, filled with alternate thin layers of nickel hydrate and flakes of pure metallic nickel. The tubes are mounted in nickel-plated steel frames or grids. The negative plates consist of thin rectangular pockets, ½ in. wide by 3 in. long, of perforated sheet-steel, also nickel-plated, filled with iron oxide and mounted on nickel-plated steel grids. The electrolyte consists of potassium hydrate in water. The container is a steel can, corrugated and heavily plated with nickel. The batteries now in use at the Bunker Hill consist of 72 cells of the G-11 type, with a 275 ampere-hour capacity. The weight of a cell is 26 pounds. Experience at this mine has shown that severe vibration or concussion does not affect the efficiency of the battery. Short circuits do not injure it. No buckling or grooving of plates has been noticed. Hydrometer readings are taken at intervals to determine whether the solution needs renewal after long use. No obnoxious fume or gas is generated when charging or discharging, although the slight amount of gas discharged immediately over the cell is inflammable, as stated above.

The first trolley-locomotive cost $1500 f.o.b. factory; now a similar locomotive costs $4000. The storage locomotives used to cost $1140 to $1500 before the War; now they cost $3000 to $6250, according to their size and type, the cheapest being the 2½-ton machine. The company now owns seven storage-battery locomotives.

An electric hoist is in use at the No. 1 or main shaft and a compressed-air hoist at the No. 2 shaft. Here I may interject the information that the main shaft is sunk at an angle of 50° and has three compartments, namely, two 5 ft. square and one 4 ft. by 5 ft. The No. 2 is sunk at an angle of 40° 30′; it has two compartments 5 ft. by 6 ft. and one 4 ft. by 6 ft. The No. 1 is extended by sinking and the No. 2 by raising. The No. 1 is used for hoisting ore, the No. 2 being devoted to the lowering of men, tools, and timber. Waste is rarely hoisted, of course; it is used for filling the stopes. The No. 1 shaft has two pockets to hold 100 tons, one is for ore and the other for waste from development work. This waste is hoisted to the adit and then dropped into chutes leading to the lower levels, from which it is drawn and taken to the stopes that are in need of filling. Both shaft-stations are concreted; the room in which the electric hoist stands, at the No. 1 shaft, is in solid rock, the walls of which have been whitewashed so as to improve the lighting. Looking from the auxiliary air-hoist at the No. 2 shaft through the rope-hole, one sees a second arch above the sheave, giving a cathedral effect, to which Mary Roberts Rhinehart referred poetically in an interview after her visit underground. The accompanying photograph shows how the impression was obtained.

At the No. 2 shaft a Hendrie & Bolthoff, 10 by 12 in., hoist is operated by compressed air. It has been in operation for six years and has given great satisfaction, I was told. It is run on counter-balance and has no ore-pocket.

The electric hoist at the No. 1 shaft was designed for duty from the 1400-ft. level, to raise a load of 7000 lb. of ore at the rate of 840 ft. per minute on a 50° incline in a skip containing 56½ cubic feet of ore. The normal cycle of operations from the 1400-ft. level is 13 seconds for accelerating, 93 seconds for operation at full speed, 5 seconds for retarding, and 18 seconds for loading below and dumping above. The hoist was made by the Allis-Chalmers Co. in March 1911; it has two cylindrical drums actuated by a 200-hp. 440-volt induction-motor, connected by gearing to the drum-shafting. The entire machine was sectionalized in order to permit of its being taken

through a 6 by 6 ft. tunnel. The total weight is 46 tons. The drums are cast-iron with a smooth surface 5 ft. in diameter and a 40-in. face, so that they can carry six layers of inch rope. The clutch is of the Lane friction type. The brakes are of the standard post type operating on wheels 6 ft. 8 in. diameter with 9½-in. faces. Auxiliary air-engines are used to operate both the clutch and brake; they are controlled from the platform. The control of the hoist is effected by means of a Cutler-Hammer multiple solenoid controller mounted in switch-board form. This switch-board controller in turn is controlled by a multi-speed master drum placed on the hoist-platform. The resistance units are of the cast grid type mounted in suitable frames. Sufficient resistance is provided for all the usual operations, with an additional section to be brought into play when operating the motor at 50% speed with 50% torque while handling men or for shaft inspection. An electrically operated oil-switch is controlled through a solenoid in connection with the master drum of the hoist; this connects and disconnects the primaries of the 2300-volt to 440-volt transformers at each trip, thereby obviating the no-load losses and magnetizing current when the hoist is idle.

The special feature of this hoist is the absolute control of the maximum demand at the time of acceleration. The time of acceleration and the maximum amount of current that can be drawn is controlled by the series relays; therefore the engineer cannot hasten the acceleration by rapid application of the controller. The following data indicate conditions developed during hoisting in balance:

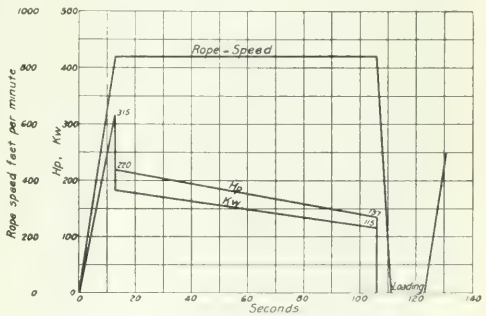
Level.	Hoisting distance on 50° incline	Pounds ore per trip	Kw.-hours per trip	Hoisting time in sec. per trip	Loading time in sec.	Time in sec. full time between bells
10	370′	7000	1.91	34	12	46
11	600′	7000	2.73	50	12	62
12	900′	7000	3.92	72	12	84
13	1170′	7000	5.05	92	12	104
14	1430′	7000	6.13	111	12	123

As an example of the duty performed by the hoist, I quote figures for the month of my visit, September 1919, as follows:

Number of tons hoisted from shaft (all levels)	24,740
Number kw-hr. consumed in the month (all hoisting including chippy work, etc.)	38,850
Average kw-hr. cost per ton of ore hoisted	1.57
Average cost in cents per ton of ore hoisted (electric power only, rate 0.625c. per kw-hour)	0.98c.

At the time when this hoist was first mooted the only electric hoisting in the district had been done at the Hecla mine, using a fly-wheel motor-generator. This hoist had proved successful, but costly; it came into service at the time when the Washington power-plant was just completed and the power company required that type of hoist in order to 'iron out', or average, the peaks in the consumption of electrical energy, and as the hoist was of a very expensive type, Mr. Clark was not in favor of buying one like it for the Bunker Hill. No straight-induction hoists of large capacity had been used in the Coeur d'Alene, but after a careful analysis of all the data available, Mr. Clark recommended the purchase of the Allis-Chalmers hoist as above described, but before placing it in position it became necessary to obtain the power company's consent to the connecting of such a hoist to their electric system. The Washington Power Co. gave consent, being influenced favorably by the type of control selected. This provides for automatic acceleration and prevents peaks above a fixed level.

The accompanying diagram shows the cycle of operations between bells, when hoisting in balance from the 1400-ft. level. The net weight of ore is 7000 lb.; the speed of the rope is 840 ft. per minute; the hoisting distance is 1430 ft. on a 50° incline, the maximum current is 90 amperes, the minimum pressure is 2080 volts, the power consumed is 6.13 kw-hr. per trip. At the stroke of the bell the engineer opens the controller to its maximum capacity without hesitation and the automatic features of the control provide for a predetermined acceleration. In this instance it requires 13 seconds to accelerate



LOAD-CURVE OF ELECTRIC HOIST

from full stop to full speed, and it demands 315 hp. during these 13 seconds. The power consumed then drops immediately to 220 hp. and gradually diminishes during the period of hoisting—106 seconds—until it is only 137 hp., when the controller is closed and the loaded skip is carried by its own momentum into the pocket, completing the cycle in 111 seconds from the bottom to the dump. Twelve seconds are required to load the other skip, when the cycle is repeated.

This hoist is geared and therefore is noisy; it is a crude and rough machine compared with later designs made by the same and other manufacturers. It was chosen on account of its high efficiency and rugged durability, two expectations that have been amply fulfilled, as is shown by the kilowatt-hour cost per ton hoisted.

If it were a question of selecting a new electric hoist today, and if the matter of first cost were not critical, Mr. Clark would prefer, he tells me, a hoist of the motor-generator fly-wheel type, such as the Ilgner, because, although expensive, its smoothness of control and general efficiency recommend it; but for strict economy, and where looks don't count, he would again recommend the straight induction-motor type with automatic accelerating features like those of the hoist at the No. 1 shaft in the Bunker Hill mine. The automatic feature is admirable; the engineer has no control over the period of acceleration and therefore cannot establish unduly high peaks by excessive acceleration. When raising men, the

hoist operates at half-speed; this is done by slow application of the controller to half of the quadrant, registering the amount of resistance units that have been cut out.

I may add that at the time of selecting a hoist for the No. 1 shaft, the various types of hoist were passed in review. The use of compressed air was rejected on account of the length of the adit (two miles from the air-compressing plant), which would require the placing of compressors inside the mine close to the hoist or an expensive pipe-line from the outside, together with the reheating of the air before delivery to the hoist. The congestion of pipe-lines in an adit of such small cross-section would have been most objectionable. The first cost also would have been excessive, and the operating cost would have been high on account of the extra attendants. A suggestion was made by an engineering firm to use a synchronous motor directly connected to an air-compressor underground, to be installed with a series of small air-receivers (small on account of the dimensions of the adit) to supply air for an air-operated hoist, but the idea was rejected on account of the excessive outlay, the cost of attendance, and the amount of money to be invested in expensive apparatus that could not be removed from the mine in case of a temporary shut-down, and the rapid deterioration of such machinery if left in the mine during a period of idleness, and the probability of the receivers leaking by reason of the constantly varying pressure and temperature caused by the erratic demands of a hoisting-load. The Ilgner type of hoist was rejected for many of the same reasons, such as excessive first cost, inability to remove such parts as would suffer during periods of idleness, and especially the probable damage to the direct-current motor-commutators that would be caused by excessive 'sweating', whereas the hoist selected would raise the ore as cheaply as, if not more cheaply than, any other hoist available; and on account of the moderate sum of money invested the hoist need not be expected to operate beyond a moderate capacity, so that another hoist could be purchased advantageously in case it were demanded by future requirements; in short, it was deemed wise not to look too far ahead. The pumps in the mine are operated electrically. The new pumping equipment includes four centrifugal Cameron pumps of the turbine type, one each of three-stage, four-stage, seven-stage, and ten-stage. They make 1800 r.p.m. and have proved most satisfactory. As successive new levels are opened up, the flow of water increases until the ground overhead has been drained of its free ground-water; after that there is a steady seepage, so that a graph of the water pumped from the mine shows peaks at regular intervals coincident with the opening of new ground and a constant increase with depth due to the drainage of a steadily widening area.

I noted three or four carborundum wheels driven electrically. One stone was fine and the other coarse, each had a diameter of one foot; together they consumed about two horse-power. The use of these grindstones underground saves much time; in 10 or 15 minutes one machine does the work of two men, one to turn the stone and the other to hold the axe for approximately an hour.

The accompanying photographs explain themselves. On the first page is shown the automatic tell-tale device that trips out the motor when any loose end in the rope sticks out. The device is shown in position; the end is electrically connected to the trip-coil fastened on the oil-switch. Two illustrations show the shaft-station with its concrete arches.

(To be continued)

Mining in Queensland, Australia

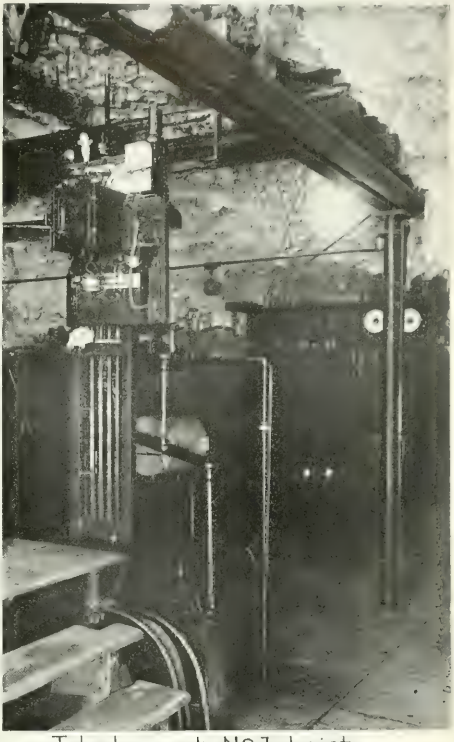
The mineral production of Queensland, Australia, last year was valued at £2,472,000, which was £268,700 less than during 1918. This decrease was due, not to declining resources except as regards gold, but to the great reduction in prices that followed, early in the year, upon the release of large quantities of metals, that had been held in reserve by the British government for war purposes; to a great scarcity of explosives; and to the existence of drought conditions for some time. In late years there has been an expansion in Queensland's mineral output apart from gold; and, prices having gradually recovered themselves in the course of 1919, the production of the last quarter of that year was higher than for the corresponding period of 1918.

Still further proof that the large northern State of the Australian commonwealth was recovering from its 1919 set-back in the output of industrial metals is afforded by the returns for the first quarter of 1920, which have just been published and which amount to £602,270, a comparative increase for the three months of no less than £351,360, or of 58%. In May, however, a disquieting effect was produced by copper dropping to below £90 per ton and tin to £270. More copper is now produced in Queensland than any other metal. The principal copper mines are in the Cloncurry district, over 500 miles from the coast at Townsville; and in this remote district, where the conditions of living are not alluring, the cost of production is high. The manager of one company has stated that it can now produce the metal at a cost of £61 per ton, which should give a handsome profit even at the present price; but the other big companies of the district, whose mines are not so rich or easily worked, had to shut-down in 1919 when copper dropped below £80, and will no doubt have to do the same again if quotations reach that level.

TWO MINING COMPANIES, the Finland Copper Co. and the Salla Mining Co., have bought some large deposits of copper ore which have been discovered in Kuolajarvi Parish in the Oulanka River valley in northern Finland. Geological examinations have shown that the copper near the surface is rich, and if diamond-drilling is used it probably can be ascertained whether mining on a large scale will be profitable or not. The directors of the companies have applied for a Government subsidy for this purpose, as security for which they offer shares of old stock at a nominal value of 200,000 Finnish marks. There are also rich veins of pyrite in the same place, apparently amounting to several million tons. Diamond-drilling will show the depth of these veins.

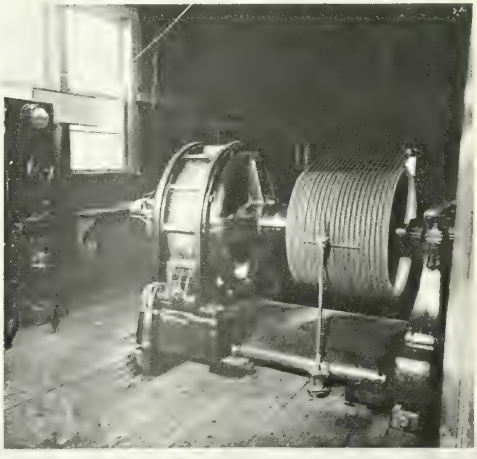
Electric Apparatus at the Bunker Hill

Storage-battery locomotive underground

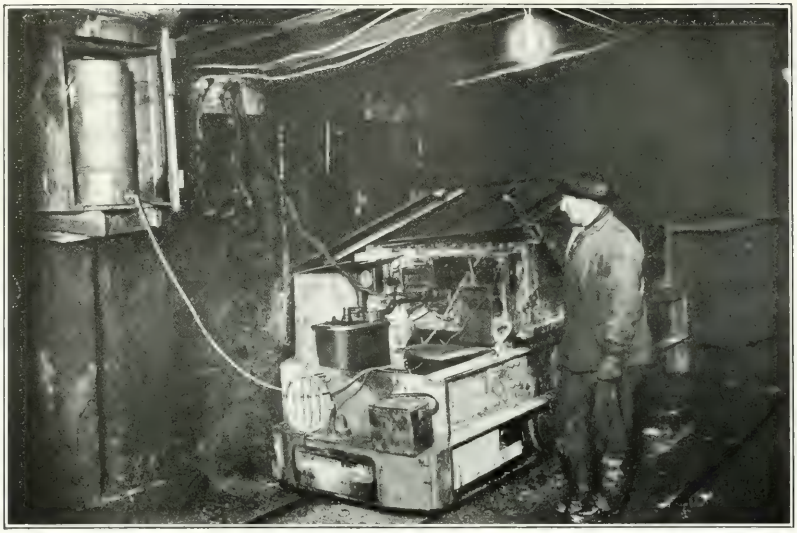


Telephone at No 1 hoist connecting with all levels

Electro-magnet above rolls

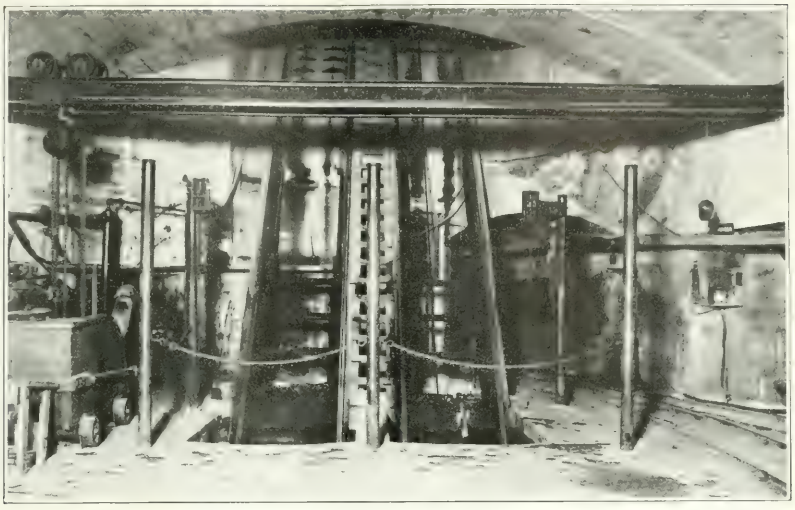


Tripper on rope-drive

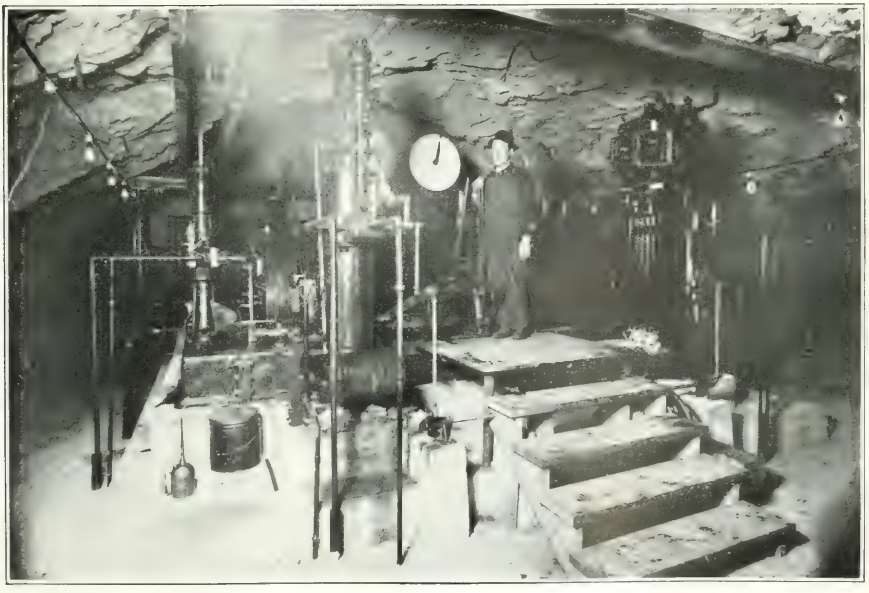


RE-FILLING EDISON STORAGE-BATTERY CELLS WITH DISTILLED WATER, USING NOZZLE EQUIPPED WITH AUTOMATIC ALARM

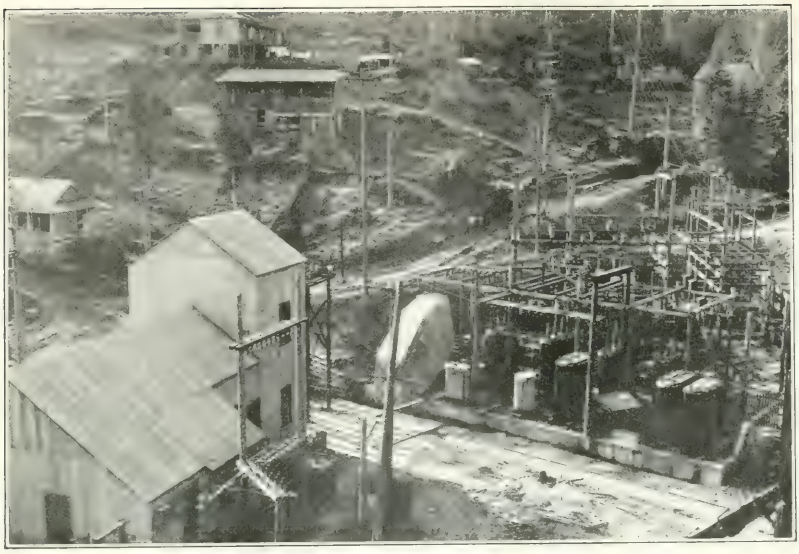
No. 1 SHAFT STATION IN KELLOGG ADIT, SHOWING CONCRETE LINING, SKIP WAY, DRINKING FOUNTAIN AND MINE TELEPHONE



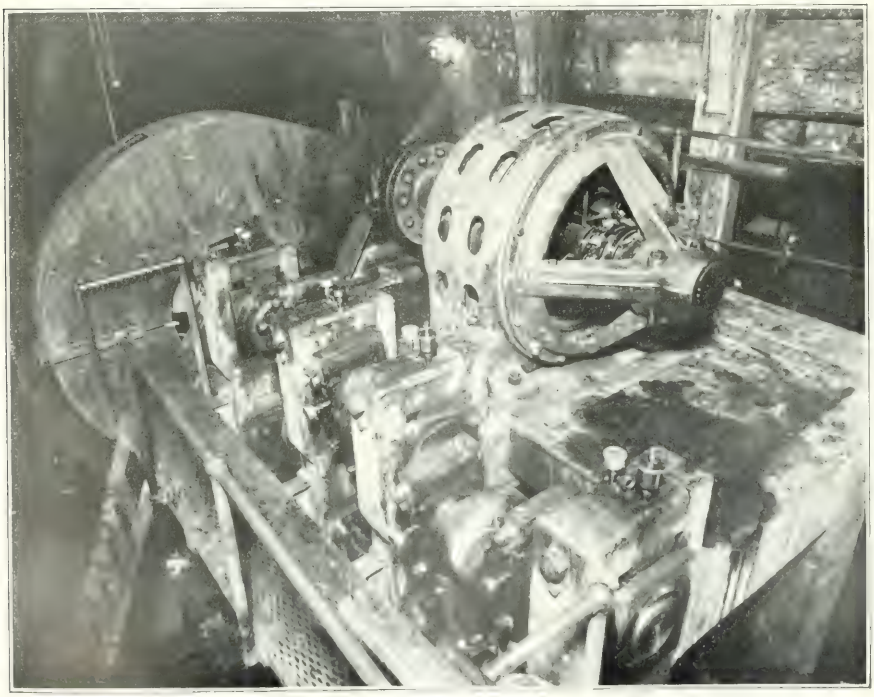
THE COLLAR OF NO. 1 SHAFT IN THE KELLOGG ADIT



THE ELECTRIC HOIST AT THE NO. 1 SHAFT



OUTDOOR SUB-STATION OF THE WASHINGTON POWER CO.



THE QUINTUPLEX CENTRIFUGAL PUMP THAT WAS STARTED AFTER BEING SUBMERGED TWO WEEKS
ELECTRIC MOTOR ON TOP OF PUMP.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ALASKA

ACTIVE DEVELOPMENT AND PROSPECTING ABOVE HYDER.

HYDER.—The season's work has been well under way on the Portland Canal district for some weeks. With the snow gone and prospectors and miners in the hills the towns of Hyder and Stewart are almost deserted. On the properties along the Salmon and the Bear rivers activity prevails. The only notable new discovery is on the Georgia river, a few miles below Stewart, where a number of gold-bearing claims have been recorded. Samples indicate that there is some rich ore and that the showing warrants development. The Marmot river also is being prospected and promising claims have been located. Development work is continuing on all the better-known mines and prospects and road construction is in progress to assist in the opening of the mineral region. The Unicorn group is to be drilled, a contract having been awarded to Lynch brothers, of Seattle, and F. P. Stewart has returned to the camp to supervise plans for opening the Mountain Boy group of Crown-granted mineral claims. He is a pioneer of the Portland Canal district, being credited with directing the attention of Sir Donald Mann to the possibilities of the district. Shipments are being made regularly from the Premier mine, and prospecting and development by diamond-drilling are proving up additional ore.

COLORADO

NEW REDUCTION PLANT AT BOULDER.

LEADVILLE.—Operations have been resumed on the Collins group of the Golden Calf Mining Co. in Sayers gulch. Denver people have secured a bond and lease on the property. Aspen men are operating on the Ruby property in Lincoln gulch, following a long period of inactivity. The mine produced high-grade ore when last operated. South of Sayers gulch, Leadville miners are developing a promising orebody on the Tellurium lode, owned by W. E. Wright of Twin Lakes. The ore is rich in gold. The Burge group on the north slope of East Red mountain is being developed by a tunnel now in 1200 ft. The formation is rhyolite but no vein has yet been cut. Gouge of clayey matter contains pyrite carrying some gold.

FAIRBANKS DISTRICT, ALASKA

BOULDER.—The Tungsten Products Co. is installing a chemical reduction-plant for the treatment of radium-bearing ore at its plant in this city to be completed during August. The ore to be treated is mined at Gateway, on the western slope. It is claimed that the uranium and radium will be recovered and the mill will be equipped to handle in addition tungsten and vanadium. The tungsten mining industry at Nederland in Boulder county is at this time practically at a standstill.

GEORGETOWN.—T. B. Burbridge of Denver, operating

the Jo Reynolds and American Sisters mines under bond and lease, is shipping a fair grade of ore obtained from development work, and is reported to have netted $5000 in the first six months of 1920. Sub-lessees are also shipping. The Utah Copper Co. is reported to be financing the development of the Alice placer in this district. The Pennsylvania group is again active and will be developed by Eastern interests. The Canadian Syndicate is operating the Gem Mining & Milling Co.'s group near Idaho Springs, with W. E. Renshaw in charge. Ore-bins have been constructed at the Mount Kelso mines, and cabins are to be built to accommodate miners during the winter months, as continuous operation is planned. The group is developed by a tunnel. Ore has been opened on the main vein and shipments will start shortly.

Cripple Creek.—The test-drilling in the north end of the district has reached the 800-ft. point, with the core of the drill still showing nothing but granite. The rock is much harder and the two shifts are advancing about 20 ft. per day instead of 40 ft., as recorded for the first 500 ft. Lessees on the third level at the Lee shaft of the Isabella Mines Co. have installed an air-hoist and are hoisting ore from the vein recently opened. The ore is sampling one ounce in gold, and, as the vein or dike is fully 12 ft. wide, ore is made rapidly. One round of machine-drilled holes breaks more than the shovelers can handle on one shift.

Telluride.—The mill of the Colorado Vanadium Co. is running steadily on vanadium ore from the Sawpit district and there is a good market for all ore mined. A recent shipment to the plant of the Ore Products Co. at Denver, from the Donegan property at Sawpit, netted the shipper nearly $1000 for a 26-ton carload.

Silverton. Machinery and equipment for the Martin Mining & Power Co.'s group of claims in the Picayune basin near Eureka, has been shipped to Denver and has been hauled to the property for immediate erection. Development on a large scale is planned. Sam Heidel, owner of the Mazeppa group in the South Mineral section of the San Juan, is mining a good grade of ore, in a tunnel driven to cut the Mazeppa vein at greater depth than the shaft workings. Shipments will shortly commence. Denver interests have purchased the Bandora group in the South Mineral section for a consideration reported to be $100,000. A large tonnage of ore is blocked out and a milling plant will be constructed for local treatment of low-grade, according to the present plan. Ore of shipping grade will be consigned to the A. V. smelter at Leadville.

Ouray. Mines in the Red Mountain, Sneffles, and Bachelor districts have been examined and samples forwarded to the Golden School of Mines for testing. Experimental tests are in progress at Golden to determine a satisfactory process for treatment of these low-grade complex ores. A discovery on an unpatented property, immediately adjacent to the Paymaster mine in the Ironton section has been made by James Davis, well known prospector of this city. A 4-ft. vein, believed by Davis to be the extension of one of the rich Paymester veins, has been cut. Assays were high enough to warrant Davis shipping a trial lot to the smelter.

IDAHO

POPE SHENON PROPERTY MAY CHANGE HANDS.

Salmon City.—An offer to purchase a controlling interest in the Pope Shenon Mining Co. on the basis of $2 per share for the stock has been submitted to the directors of the company. It is believed that the offer is made on behalf of large Eastern copper interests. The company is capitalized for 1,000,000 shares. Most of the stock, of which slightly more than 800,000 shares has been issued, is owned by Salt Lake City people who financed the development of the property and construction of the mill. A volatilization mill was completed recently, having a capacity of 50 tons per day. The offer provides for an option on not less than a controlling interest, the option to permit a 30-day period in which to survey the property, during which time the company would continue operations. At the end of 30 days the holders of the option would take over the operation of the mine for further development, but would ship no ore. The development work is to occupy a period of five months. At the end of that period, should the option be exercised, a payment of $500,000 would be made and the balance would be paid six months later. While the offer provides that controlling interest be acquired, it is desired to purchase the entire outstanding stock. The directors of the company have authorized R. H. Winder, president, to appoint a committee of three to investigate the proposition. The new mill was shut-down recently, following its initial test-run, to repair the damage done to the Cottrell electric-precipitating plant by fire. These repairs have been completed and the mill is again in operation. It is stated that there is approximately 100,000 tons of ore in sight in the mine, and the work of connecting various tunnels and raises is now under way.

MICHIGAN

CONTRACT LET FOR RE-TREATMENT-PLANT FOR TAMARACK SANDS.

Houghton.—Calumet & Hecla's success with its 'reclamation' plant, which at present is yielding at the rate of 15,000,000 lb. of refined copper per year, is reflected in the awarding of a contract to the American Bridge Co. to erect a complete plant for the treatment of Tamarack sands. The contract, it is understood, involves the expenditure of $1,000,000 for buildings and equipment. The new venture will be a replica of the Calumet plant, for it will include re-grinding, leaching, and flotation, and in size will equal the C. & H. plant. The site, now occupied by the old Tamarack mill, is being razed rapidly, and as soon as possible foundations will be put in. Because of the immensity of the project it is not likely that steel-construction work will begin until fall and more than a year will elapse before the plant is completed. The awarding of the contract bespeaks Calumet's faith in

the Michigan copper country and its full appreciation of the development of metallurgical processes. The Tamarack sand contains, it is estimated, from 15 to 40 lb. of copper per ton and its treatment will afford an excellent profit.

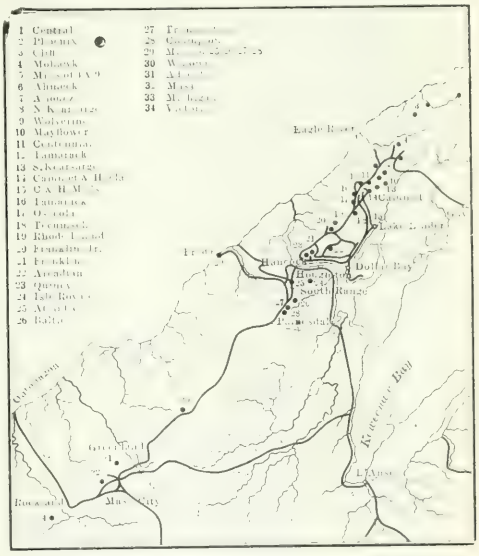
Quincy recently hoisted a 'mass' weighing 24 tons. This came from No. 2 shaft, which last year produced 1290 tons of mass copper. Incidentally, in the stope from which the mass was removed, another of still greater dimensions was uncovered and it will be brought to surface within the next thirty days. The first mass was 8 ft. long, 4 ft. wide, and slightly more than 4 ft. thick. It was so cumbersome that it was necessary to cut it into three pieces in order to get it into a skip. Acetylene torches were used for the work. In the old days such a task would have required weeks, for hand-chiseling was the only method known for cutting it. The mass came from the 82nd level.

Baltic's sub-shaft, which will connect No. 2, 3, and 4 shafts, will require more than a year for completion. It is being driven at the bottom of No. 3 shaft on either side, and will connect on the 33rd level of No. 2. When complete, all hoisting for No. 3 will be done through No. 2, and considerable expense thereby will be avoided. Baltic's operations have been carried down to a depth of about 3900 feet.

The Mayflower-Old Colony south drift, which perhaps is the most important work in the exploration program, is breasted in a mixture of trap and vein-rock and is still going forward. In the north, the cross-cut still proceeds eastward, while the raise in the west cross-cut has penetrated some vein matter, with characteristics of the Mayflower formation. Mayflower feels the shortage of men to some extent, for many miners have gone to their farms and will not return to the mine until after the harvest.

Seneca's third and fourth levels, north, are producing rock of slightly better quality than for the past three weeks, with the third level drift at a point 469 ft. from the shaft and the fourth, 412 ft. from the shaft. The south drift on the third level, which reached the Ahmeek boundary a week ago, was in comparatively rich ground for almost its entire distance, and the fourth level, south, also is yielding good rock. The south drift on the fourth level is 260 ft. from the Ahmeek limits, which will be reached at 430 ft. The shaft has about reached the depth at which the fifth level will be holed-through and the forms are being installed for concreting the floor. When the concrete is poured and set, sinking will be resumed in order to put the raise up through the floor of the level. In the meantime it will be necessary to cross-cut to the lode. The concreting of the shaft will in no wise interfere with operations on the third and fourth levels, for the shaft already has been concreted from the fourth level upward. Little rock is being stamped of late, due to the labor shortage, and it is accumulating until sufficient quantities are available to warrant a mill-run. Gratiot's thirteenth-level drift, south, reached a point 506 ft. from the shaft on the 19th of the month and is going forward rapidly. The ground for the past week is described as favorable.

Apart from the order for France, Calumet & Hecla has caught up on its orders, and shipments of metal practically are at a standstill, except for an occasional carload that goes to Kenosha, Wisconsin. Quincy's shipments are negligible and comparatively small quantities are being shipped by the Copper Range and Stanton groups. The Calumet order for export calls for billets and wire bars only, hence three weeks will be required to turn it out. Of 1500 tons that left early in the week for domestice consumers, Calumet's portion was 700 tons. In addition to its refined-copper shipment,



MINES IN THE LAKE SUPERIOR COPPER REGION

Calumet ships about 120,000 lb. of copper oxide per month.

The announcement that steps have been taken to provide fuel for the North-West was received with pleasure here, for it ensures winter coal for those mines that can afford to pay the high price. In some quarters a decline is looked for, but unless the drop is material it is certain that treasury surpluses will have to be drawn upon. The Copper Range mines, to illustrate, consume from 75,000 to 80,000 tons of coal per year and at present prices, $10.50 per ton, the increase will mean upward of $500,000 for this group alone.

MONTANA

NEW OREBODY OPENED IN THE FLOHART MINE.

NEIHART.—The Hartley mine is again in the list of regular producers. From the bottom of the shaft at the 300-ft. level, drifts have been driven on the vein and stopes have been opened 50 ft. in each direction from the

shaft. It is planned to open up more stoping-ground and double the present production.

The newly opened shoot at the Flohart mine has the characteristics of an extensive high-grade orebody. The present development consists of carrying ahead all the levels from No. 1 to No. 5 with a series of raises and chutes, so as to bring all the ore out of No. 1 tunnel to the ore-bins above the railroad track. The 500-ft. shaft will be drained to the 200-ft. level where the old workings will be explored; 20 men are employed at the mine. This mine has been operated intermittently for the past 30 years and is credited with a production of about 4,000,000 oz. of silver.

Helena.—Considerable development work is being done on the Jawbone property. Machine-drills have been adopted, making progress in tunneling and cross-cutting more rapid. Metallurgical tests on the ore are being made to determine the concentration method to be adopted for the mill that is to be erected. Gold and silver are the chief metals.

Philipsburg.—The mines of this district are now producing 500 tons of manganese ore and more than 400 tons of silver ore daily. About 1000 men are employed at present in the district.

Deer Lodge.—The Champion mine of the Butte-Jardine company is making regular shipments of high-grade ore to the Washoe smelter at Anaconda. Work on the new mill is progressing satisfactorily. Recent development in the mine includes an 11-ft. winze in rich ore, and a tunnel 130 ft. on the orebody. Smelter returns on the last shipment gave 72.6 oz. of silver and $4 in gold per ton; 43 men are employed at the mine and mill.

NEVADA

NEW REPORTS FROM DIVIDE.

Copper Canyon.—The Homestake Consolidated Placer Mines Co., operating on the Guy Davis and Homestake claims, has finished sinking shafts and is preparing to start washing gravel. In April these claims were awarded to the Homestake Consolidated by the United States Supreme Court after years of litigation. There is little water near the claims, but by re-using the water it is thought the supply will be ample. More than five ounces of gold was recovered recently from one yard of gravel. The company has purchased 11,000 ft. of pipe to carry water to the claims. The work is in charge of William Forman, of Tonopah, who aided George B. Thatcher, formerly attorney-general of Nevada, in the court actions. The claims originally were held by the Glasgow & Western, an English exploration company, as lode claims. They were located as placer claims in 1913 by two miners, and when the locators disobeyed an injunction secured by the Glasgow & Western they were put in jail and remained there until their plight was brought to the attention of Thatcher, who took their case without charge and secured their release. One of the men, Guy Davis, interested others and the claims were again located and work was started, only to be stopped by a second injunction. Davis took his case to Thatcher, who interested Forman, and in return for a share in the ownership of the claims the two attorneys went into court and secured a verdict in their favor on the ground that mineral in place had not been found on the claims. The case was appealed to the Circuit Court, which reversed the verdict. Thatcher and Forman then appealed to the United States Supreme Court and won their case after all of the locators had lost confidence and had sold out to friends of Thatcher. The claims cover what engineers say is the richest placer ground in the country.

Ione.—Robert B. Todd of Reno has financed in New York the construction of a 50-ton mill at the Star of the West, 20 miles north of Ione, in northern Nye county. The Star of the West is an old producer of silver-lead ore that has been re-opened by the cleaning of three tunnels and by work from them. Ore assaying $20 for a width of 7 ft. has been found in surface trenches and assays of $7 to $18 have been secured from 6 to 10-ft. widths in the tunnel-workings. The lowest tunnel is 350 ft. long and it is to be continued 800 ft., or well into the San Francisco claim.

Eureka.—The Prince is preparing a shipment of high-grade ore from the 140-ft., or bottom, level, where the shoot is 3 to 4 ft. wide. Some of the ore being saved assays more than $200 in silver and gold in the proportion of 1 oz. gold to 50 oz. silver. The drifts on this level are in a shoot from which good shipments were made at the surface. All of the work on the Prince in former days was done at or near the surface, most of the production being made from a depth of less than 50 ft. The output from these workings is estimated to have been nearly $750,000. The Croesus is shipping $80 ore regularly, most of it being mined 1500 ft. north of the Catlin shaft, on the 400-ft. level. The Holly is shipping $75 ore at a rate of 50 to 75 tons weekly from the 400 and 500-ft. levels. Sinking of the shaft from 450 ft. has been started. Shipments that net the company more than $5 per ton continue to be made at a rate of 50 to 75 tons daily from the 900-ft. level of the Locan shaft of the Ruby Hill Development Co. There is estimated to be 50,000 tons blocked out. Sinking of the shaft from 1200 ft. has not yet been started. The Climax is preparing a shipment of ore saved in driving the Mabel L. tunnel, which is now well into the Deadbroke claim. No stoping has been done. There is a 3-ft. width of ore of shipping grade, with a 6-in. seam that is rich, in a 70-ft. winze at the 1500-ft. point in the Eureka tunnel of the King. An air-power hoist has been put in place and the shoot is being explored further.

Divide.—A drift in the main vein of the Tonopah Divide near the Gold Zone line and on the fifth level has exposed 2½ ft. of 158-oz. ore. Rich ore also has been found in new work in the main vein on the third level and the main south-east drift on the first level is being continued in a full face of 70-oz. ore. According to reports it is probable that there is good ore for 150 ft. beyond the present face of the drift on the first level, as a raise this distance south-east, from the second to the

first level, is in ore. This raise was driven 105 ft. in good ore. It has been learned from an authentic source that the distance between the point where the main southeast drifts on the third, fourth, and fifth levels were turned from the main vein, and the Zone line, is more than 400 ft. These reports indicate that the main vein has not been explored for this distance. The ore recently found on the third and fifth levels is in drifts from cross-cuts driven to the main vein from the workings made by the former management. The Victory has resumed sinking the winze from the present depth of 360 ft. An electric hoist is being used and the winze will be continued another 100 ft. One carload of ore assaying 30 oz. silver and 0.25 oz. gold has been shipped from the 310-ft. level, from which the winze was started, and 100 tons of the same grade is ready for shipment according to reliable advice. Only low-grade ore, assaying $8 to $10, was found on the 360-ft. level. The shoot is 60 ft. long and 3½ ft. wide on the 310-ft. level.

CARSON CITY.—The Comstock Superior Co., operating in North Carson field, is preparing to sink on the junction of a cross-vein with the main lode. Several cross-veins have been found and the main orebody traced the full length of the group. Sinking is progressing steadily at Nevada Protective.

UTAH

FIRE DESTROYS SAMPLING-MILL AT THE MURRAY SMELTER.

SALT LAKE CITY.—Fire, thought to have originated from a burning cigarette, destroyed sampling mill No. 4 of the American Smelting & Refining Co.'s smelting plant at Murray, seven miles south of here, on July 26. The property loss is estimated at $50,000. The mill was built about 12 years ago, and was the last of a series of four sampling mills, being adapted to the handling of ore that could not be sampled in the other three mills.

MECHANICAL VENTILATION IN THE SPECULATOR MINE AT BUTTE

PARK CITY.—Mining operations have been resumed at the Three Kings property, following several months of exploration work with diamond-drills, which was done for the purpose of locating known ore-bearing lime beddings, according to P. J. Mackintosh, general manager. The drilling work furnished information of value in guiding mine development. A further increase was made in ore shipments from this district during the week ending July 24, when 2349 tons was shipped, as against 2267 tons for the previous week. The Ontario Silver shipped 911 tons; Silver King Coalition, 645 tons; Judge M. & S., 364 tons; Daly West, 170 tons; and the Naildriver, 165 tons. The Judge smelter shipped 94 tons of premium spelter.

Big Cottonwood Canyon.—The stockholders of the Reed's Peak Mining Co., at a special meeting, unanimously voted to consolidate the property of the company with that of the Big Cottonwood Consolidated Mining Co., adjoining the Reed's Peak to the south. The new company is to be called the Reed's Peak Consolidated Mining Co. The property consists of an attractive group of 32 claims, located in the south fork of Big Cottonwood canyon, one-half mile north of the Cardiff mine and 22 miles south-east of Salt Lake City. The new company starts out free of debt, with $8000 cash in the treasury, and with ample equipment in the way of tools, machinery, mine buildings, cars, and track. The portal of the Reed's Peak tunnel is but 12 miles from the Murray smelter. It is the intention of the management to begin operations immediately.

Conditions in the Cardiff mine are reported as excellent; an average of 50 to 60 tons per day of silver-lead ore is being shipped, that averages about $55 or $60 per ton. Five teams are engaged in hauling the ore down the canyon.

Milford. Three lessees are mining exceptionally high-grade ore from the 'Wild Bill' mine, which adjoins the Cedar Talisman property; the last car of ore shipped netting $4000 after payment of all charges, including royalty. The shipment averaged 61% lead and 38 oz. silver per ton. The property was opened by an incline shaft, but the company stopped operations before ore was found. The lessees sunk a short distance in a winze from the shaft before cutting high-grade ore. Mine development is increasing in Beaver county. J. M. Reynolds, who financed the Capitol company, which is now developing its property, has recently been successful in financing the old Humboldt group. Equipment has already been installed on the property and shaft sinking started. At a depth of 35 ft. a promising vein was struck, from which high-grade samples have been taken. It is the intention to sink this shaft to the 500-ft. level.

At the old Monitor property, the new lower tunnel has almost reached a north-south fissure that has enriched bedded deposits, which furnished good shipping ore in the upper levels of the mine. The tunnel has been driven 250 ft. and is about 40 ft. from its objective. Small seams of high grade ore have been cut, which have assayed as high as 52 oz. in silver and 63% lead. William Gore, president and manager of the property, is well satisfied with the progress being made.

American Fork Canyon. Ore was found recently in a raise from the Holden tunnel which is being driven to open at depth the orebodies mined near the surface in the Live Yankee, Silver Wave, and Bellerophone properties. This is the first prospecting at great depth in this part of the district and is of importance on that account. The Holden tunnel is being driven by the American Leasing Co., controlled by C. B. Ferlin, former superintendent of the Pacific mine; the leasing company operating the three properties named, under a lease. In the early days, some of the richest silver ore found in this district was mined in the Live Yankee property. The ore was found as large boulders of galena, lying in the bed of a stream which follows an east-west fault fissure. Much of the early-day mining in this part of the camp was done by A. L. Holden, later associated with the United States Smelting Co., and Mathew Cullen, of Salt Lake City, who were pioneers among Utah mining men. The American Leasing Co. developed considerable milling ore in the upper workings of the old properties and then built a small concentrating mill. The milling ore developed at a point 185 ft. above the Holden tunnel has been opened from 8 to 15 ft. in width.

Eureka.—The suit of the Tintic Delaware Mining Co. against the Salt Lake, Fillmore, and Kanosh Railroad Co. has been decided in favor of the plaintiff. The suit was instituted to recover $5000 and interest on money alleged to have been advanced to the representatives of the railroad company for the purpose of assisting in the building of a railroad from the Salt Lake Route in Millard county to the Deseret Mountain mine and other properties in the West Tintic district.

Walter Fitch Jr., mining contractor, who is sinking the new shaft at the Chief Consolidated mine, states that a depth of 1440 ft. has been reached and that the formation is changing. It is understood that the shaft is nearing the lime, as the formation is loose and large boulders of lime are making their appearance. This loose formation will necessitate using solid concrete lining instead of hollow concrete forms, such as were used in the upper part of the shaft. Excellent progress has been made in the sinking of this shaft, an average of 61 ft. being made each month. The shaft will be sunk to the 2000-ft. level before extensive lateral work will be started.

Ore shipments from this district for the week ending July 24 totalled 145 cars, an increase of 9 as compared with the previous week. The Chief Consolidated shipped 50 cars; Tintic Standard, 27; Victoria, 9; Eagle & Blue Bell, 8; Iron Blossom, 8; Dragon, 8; Grand Central, 6; Iron King, 6; Centennial-Eureka, 5; Mammoth, 4; Bullion Beck, 4; Gemini, 3; Tintic Drain Tunnel, 2; Gold Chain, 2; Colorado, 1; Swansea, 1; Ridge & Valley, 1.

BRITISH COLUMBIA

INTERNATIONAL CONVENTION AT NELSON.

Hedley. There now are employed at the Nickel Plate mine about 150 men, two-thirds of whom are at work underground and the remainder at the mill and power-plant. The company is extracting gold-bearing ore averaging $9 per ton. As it costs about $8.50 per ton to mine and mill, the profits are not large. Development is planned in the expectation that richer ore will be found. Ore-cars holding two tons run on a narrow-gauge electric railway for a mile out of the mine. Then the ore is dumped into a tipple at the top of a steep side-hill. From the tipple it is dumped into cars operating on long steel cables and running down a side-hill that seems almost perpendicular. The long slide to the mill in the town itself is made in two sections and passengers who go up or down on the ore-trains sit tight and pray that

nothing breaks. A trip to the 'Nickel Plate' in one of the little ore-cars beats any roller coaster.

Victoria.—That oil has been discovered in commercial quantities in the Peace River country is reported. Crude oil, it is said, will be delivered to customers before the end of the present season. In No. 1 well the bore is being enlarged from six to eight inches; this work has progressed beyond the 1000-ft. point. No. 2 well, 2½ miles below Tar island, has been started. Equipment is being installed at Hudson's Hope, and on the upper and lower Smoky river. At the San Joaquaim well it is said that 20,000,000 cu. ft. of gas is escaping daily, that it is a wet gas containing a good deal of gasoline, and that the well will be capped and provision made for the recovery of the gasoline and the saving of the gas. The Department of Mines, Ottawa, claims to have discovered a process by which crude oil may be recovered from the tar sands which occur so extensively in the neighborhood of Athabasca river, near Fort McMurray. A reserve of 55,000 acres of such land has been created.

Nelson.—From the start the third International Mining Convention, held July 20 to 24, went with a swing, and Fred A. Starkey, secretary, and his colleagues in the management are to be congratulated. There were several good addresses and a number of interesting papers that were productive of lively discussion. The side-trips to mining and metallurgical plants were enjoyed thoroughly, and every visitor came away from Nelson feeling that he had had a really instructive as well as agreeable time. The invitation to the convention finished with: "There's a Kick in every Smile—at Nelson. There's Dew in the Mountains Still', and there was. Among the speakers were Nichol Thompson of Vancouver, Glenville A. Collins of Seattle, S. S. Fowler of the Canadian Metal Co., A. G. Langley, and William Sloan, Minister of Mines. T. W. Bingay, comptroller to the Consolidated M. & S. Co., in the unavoidable absence of J. J. Warren and G. S. Blaylock, gave an interesting account of the company's doings and plans. He stated that the electrolytic-zinc plant had a capacity of 75 tons per day, and that at the present time it was being worked nearly at full capacity. This produced more zinc than Canada required, but markets had been secured in Great Britain and Japan. The company has made a long-term agreement to treat the concentrate produced by the Canada Copper Corporation, and for this reason the copper plant had been increased from a capacity of 20 to 50 tons per day. Ground has been broken for the Rossland-ores concentrator, and the plant will be finished some time next year. The water for this plant has been provided by a large pumping-station situated a mile above the smelter on the Columbia river. The pumping-plant has a capacity of 3,500,000 gal. per day. An interesting exhibit at the convention was some samples of heavy crude oil that had been collected from seepages in the extreme south-western part of British Columbia.

Armstrong.—J. Hamil has located a 6-ft. vein about a mile from the head of the Okanogan lake, and has stripped it for 600 ft. An assay from the ore gave a return of 33 oz. per ton in silver and 21% lead. This claim was staked 28 years ago, but was allowed to lapse. Mr. Hamil was one of the original discoverers. The re-location has caused considerable local excitement, and several other claims recently have been staked in the neighborhood.

THE KIRKLAND LAKE MINE, ONTARIO

Greenwood.—Notwithstanding the departure of the B. C. Copper Co., now called the Canada Copper Corporation, from this neighborhood there is a great activity in mining and high-grade ore is being shipped. The Providence mine is the leader both in quantity and quality. Some remarkably rich ore has been taken from this mine recently.

Vancouver.—Charles F. Law, of this city, recently returned from England, where he succeeded in raising money for the development of placer claims at the mouth of Slate creek, on the Tulameen river, and on Keithley creek, near Little Snowshoe, Cariboo district. The shaft on the Tulameen river property will be continued to bedrock, and drifts then will be run. Test-pits will be sunk and drifting done at the Keithley creek property. For

several years Robert Harrison has worked rich ground at Keithley creek by drifting and sluicing. His work last year is said to have given him a return of $150 per day. Last fall he sold to a Philadelphia syndicate, retaining an interest in the management of the property. The Canadian Geological Survey has placed an excellent collection of Canadian minerals on display at its branch office, in Pacific building, for the benefit of prospectors. The B. C. Chamber of Mines is making a collection of minerals for display at the fall exposition in this city. Mine-owners and prospectors are asked to contribute.

ONTARIO

MINING ASSOCIATION OF ONTARIO RESENTS IMPLIED CHARGES.

Cobalt. Following the opening of the Gillies Limit, lying adjacent to the Cobalt silver area, quite a number of prospectors entered the field on July 20, and staked a large number of claims. No discoveries of importance have been reported, but the geological conditions peculiar to the area bear a marked resemblance to the producing territory. An average of from 125 to 150 tons of ore from the dumps of the Kerr Lake mine is being shipped to the Dominion Reduction plant, and from the early returns the indications appear to be that the 75,000 to 100,000 tons of dump material may prove to be a substantial source of revenue. The price of silver will have a vital bearing on the final result.

The Mining Corporation is constructing camps and making arrangements to carry on exploration work on a group of claims in Butt township, in the Nipissing district, where there have been discoveries of pitchblende containing an encouraging amount of radium. It is said that the radium-bearing material occurs only in patches and is of a grade that should make commercial operation feasible provided the patches are not too widely separated. On August 1 the Coniagas paid a dividend of 2½%, amounting to $100,000 and making a total of $400,000 paid so far this year. The mine has produced a total of over 28,000,000 oz. of silver to date, and is still producing at the rate of close to 900,000 oz. annually. Total dividends paid amount to $10,040,000. Production from the McKinley Darragh is averaging between 55,000 and 60,000 oz. of silver monthly. Net profits are adequate to meet current dividend disbursements of 3% quarterly. The treasury surplus is more than equal to a full year's dividend requirements. Production up to the end of June reached a total of 18,907,250 ounces.

Andrew B. Cullen, of Haileybury, owner of an instrument with which he claims to be able to locate metal deposits, has been engaged by a New York syndicate to go to the Cocos islands to locate treasures hidden by the pirates of old, notably Captain Kidd. Mining men have failed to recognize any merit in the instrument during the course of experiments conducted in Northern Ontario.

The Ontario Mining Association has requested the Ontario government to institute a search of records and conduct a complete investigation of the Department of Mines. The reason for the request is that Premier Drury recently stated that the Government had found the Department of Lands and Forests to be "positively rotten", and that the Mines Department might be the next in line for investigation. Mining interests have resented the implied slander and are making a general demand to have the matter cleared up by the broadest possible investigation. They are confident that no irregularities will be found.

Gowganda.—A slab of silver ore from the Miller Lake-O'Brien mine has been shipped to the Royal Museum at Toronto. The ore is nearly one-quarter silver and the slab, which is 42 in. wide, is officially stated to contain 7000 oz. of silver per ton. It is undoubtedly the richest sample of silver ore produced by the Northern Ontario mines, since the early days of the Cobalt camp. Statements of new discoveries of a highly sensational character at the Miller Lake-O'Brien, which have recently obtained widespread circulation, are officially denied.

Porcupine.—The McIntyre, in diamond-drilling from the 1500-ft. level, has penetrated a vein of good ore at about the 1600-ft. level, the deepest point at which gold has been found in the mine. At the Dome Mines a spectacular discovery is reported at the 850-ft. level, but the statement lacks confirmation. It is known, however, that the orebody at that depth is 43½ ft. wide and has an average gold content of $7.60 per ton. Until two years ago the estimate of ore-reserves averaged only $5.10 per ton, and the increase of 50% in this value at the depth reached is regarded as of great importance. It is understood that the question of exercising the option held by the company on the Dome Extension will be dealt with at a meeting to be held in August.

There is strong probability that the directors of the Porcupine Vipond-North Thompson will accept the offer of a Toronto syndicate to underwrite 600,000 shares of treasury stock at about 30c. per share. This plan would provide funds to enlarge the mill so as to treat 150 tons daily at a cost of $50,000, as well as greatly increase the scope of underground operations.

The shaft on the Keora is down 190 ft. When a depth of 250 ft. is reached lateral work will be undertaken to cut veins No. 5 and 6, encountered in diamond-drilling which showed high gold content.

Kirkland Lake.—The Lake Shore during June treated 1535 tons of ore with a recovery of $37,546, being an average of $24.46 per ton. Production showed a falling off as compared with May, owing to a shortage of electric power. The output for the first six months of the current year aggregated $244,710. Arrangements for starting work on the Tough-Oakes have nearly been completed, a few details in connection with the taking over of the mine by the Kirkland Lake Proprietary remaining to be settled. The staff has been engaged and the mill increased in capacity by the addition of another ball-mill and other equipment. There is ore on hand sufficient to keep the mill in operation for eight months. The Burnside, which is also embraced in the merger with the Kirkland Lake Proprietary, is expected to prove an important source of ore.

OUTPUT OF THE COPPER MINES

Comparative figures of copper production for the first half of the current year reflect the condition of the market. In the first two months of this year about 300,000,000 lb. of copper was sold. This, with the 450,000,000 lb. disposed of in November and December of last year, brought total sales on that movement up to 750,000,000 lb. Since then it has been a buyers' market. While the amount of metal contracted for in that period would ordinarily cause a slight cessation in buying for a month or two, reappearance of some demand should have been made before this. Faced with such lethargic metal-market, producers are generally sticking to the curtailment schedules determined upon early last year. Anaconda is showing a slight expansion in production. Prior to April the company was producing about 18,000,000 lb. of smelter copper per month against 13,000,000 monthly a year ago. In the first six months it produced 93,250,000, or over 13,000,000 lb. more than in the same period 1919. Phelps Dodge and Utah, on the other hand, are 8,000,000 and 11,000,000 lb., respectively, behind last year.

Total production of twenty representative mines amounted to 648,023,716 lb. of blister copper in the period ending June 30 last; in the corresponding period last year these mines produced 580,098,152 lb., or about 68,000,000 lb. less. The South American mines are all ahead of 1919, Chile showing a gain of 20,000,000 lb. With its Latin subsidiary, Braden, Kennecott is up 22,000,000 lb. from its 1919 production pace. Output of these properties is shown below.

	June 1920 Lb.	May 1920 Lb.	January to June 1920 Lb.	January to June 1919 Lb.
Anaconda	12,500,000	9,500,000	93,250,000	79,950,000
Phelps Dodge	7,552,000	7,902,000	46,730,000	54,431,144
Utah	10,000,000	9,904,781	46,017,999	57,276,000
Kennecott	10,126,000	9,311,000	53,653,860	31,554,000
Calumet & Hecla	9,042,879	8,863,811	55,490,266	52,465,514
Chile	*10,000,000	10,390,000	53,866,000	30,860,000
Inspiration	7,300,000	7,500,000	41,700,000	39,200,000
Chino	4,010,069	3,930,728	22,156,025	22,261,277
Miami	4,400,000	5,054,760	27,931,482	28,152,031
Ray Con	4,520,000	4,260,000	24,964,073	23,927,000
Nevada Con.	4,650,000	4,350,000	24,871,938	23,378,482
Calumet & Arizona	3,812,000	3,810,000	21,180,000	22,188,000
New Cornelia	3,664,000	3,720,000	21,332,000	17,804,000
Arizona Copper	3,000,000	3,000,000	18,000,000	17,392,000
Old Dominion	2,999,000	2,287,400	14,432,700	14,714,000
East Butte	1,396,140	1,412,760	8,908,820	8,900,840
Granby	2,079,000	2,131,219	12,566,558	11,407,563
Greene-Cananea	3,750,000	4,300,000	22,150,000	18,200,000
Cerro de Pasco	3,944,000	6,890,000	29,668,000	28,096,000
North Butte	1,616,822	892,118	9,153,995	5,940,301
Total	110,535,910	109,490,577	648,023,716	580,098,152

*Estimated.

COURSE IN MINERALOGY

The Technical Department of the Extension Division, University of California, announces a new course by correspondence in determinative mineralogy and blowpipe-analysis by Arthur S. Eakle, professor of mineralogy. It is equivalent to the course given in the regular session of the University. Two units of university credit will be given, if desired, on the passage of an examination. Each of the ten assignments are based on portions of a textbook which is sent out with the preliminary announcement sheets. The fee for this course is $12, payable in advance. This will include all assignment sheets, the text-book, all powders and mineral specimens, a pad of report blanks, postage on all material sent to the student, and the supervisory work of the instructor over each student. Necessary apparatus for the course must be provided and will be furnished by the Associated Student's Store, Berkeley, California, on receipt of a check or money-order for $20. The difference between this amount and the actual cost will be returned. For those who have access to a laboratory or who already have blowpipe apparatus the charge can be reduced to a few dollars only. A list of the necessary laboratory equipment will be sent on application.

CALIFORNIA

Amador County.—The 1500-ft. Gover shaft of the Fremont Consolidated has been cleared of water and the pumps are now engaged in unwatering the main Fremont shaft, which is approximately 3000 ft. deep. Immediately following clearance of the lower levels repairs to the shaft will be rushed and prospecting and mining resumed. The Fremont shaft will be sent deeper and effort made to determine extensions of orebodies which formerly yielded high-grade ore. The property is being re-opened under an option by a strong company after lying idle two years.

New pumps have been added to the plant at the Argonaut mine and unwatering is proceeding more rapidly. Freezing of sections of the pumps, attributed to the use of compressed air, has caused some trouble. Repairs are following unwatering and the management is endeavoring to have the property in shape for production as soon as the water is out of the lower levels. The disastrous fire, which forced flooding of the property, is definitely extinguished, and before the end of the year the Argonaut should again take its place among the gold producers of the State.——Labor shortage is hampering work at many local mines, and at the Central Eureka the management has been forced to curtail operations to such an extent that only 20 stamps are dropping. It is presumed that with the passing of the harvest and lumbering season labor for the mines will become more plentiful.

Placerville.—The 700-ft. tunnel of the Pacific Channel Co. has entered the long-sought channel and is advancing to reach a deposit of cemented gravel. Indications point to the proximity of a large body of gold-bearing material. The property lies about 16 miles east of Placerville.

A number of small quartz and placer mines in territory tributory to Placerville are receiving attention, despite a scarcity of skilled labor and the adverse circumstances affecting gold mining. Some promising discoveries have been reported and several companies are preparing to resume placer mining as soon as the rainy season provides sufficient water.

Plumas County.—At a point 1500 ft. north of the Walker property Frank Morehouse has penetrated a 16-ft. vein of good ore at a depth of 510 ft. This development, while generally predicted by those who were familiar with the country, gives promise of another producer.——Arizona parties have taken a bond on the Five Bears mine, and will

soon commence extensive work there.——Spokane capitalists have taken a bond on the Eagle group and plan development on that property and San Francisco interests expect to commence work on the Trimetallic group adjoining the Engel mine.——Work on the Beardsley copper mine and mill is going ahead satisfactorily. Tunnel No. 3 is rapidly nearing completion. This will facilitate handling the ore from the mine to the mill. Some mill machinery is installed and more is on the way. The owners are planning to enlarge the capacity of the mill, as recent work has demonstrated that the orebodies are greater than was estimated.

Redding.—The Bully Hill Mines Co. has purchased the Balaklala Copper Co.'s smelter buildings at Coram to get structural steel for erecting reduction works and other buildings at Bully Hill. None of the machinery at the Balaklala smelter was purchased. It is estimated there will be 200 carloads of steel to be shipped by rail to Bully Hill, where workmen already are grading for the new buildings.

COLORADO

Denver.—The management of the Lackawanna Oil Shale Products Co. announces that the first unit of its plant near DeBeque is almost completed. The first unit, it is stated, will handle 250 tons of shale per day. It is the intention to increase the size of the plant to 1000-ton capacity. A pipe-line is now being laid from the plant to DeBeque, a distance of 7½ miles, from which point the company expects to ship its finished product. John Gaffy, president of the company, has spent several months in studying various processes for the extraction of oil from shale and it has been decided to use the Randall method, which is reported to be far simpler in mechanical operation than many of the other methods. The Randall process, it is stated, is a modification of the inventions of J. W. H. Randall, which were used with reported good success during the War by the American and Allied governments in the manufacture of wood alcohol and acetone, from waste wood products, both substances being used in the manufacture of munitions.

IDAHO

Coeur d'Alene.—The Russell shaft, being sunk by the Federal company to prove its contention in the apex litigation with the Hecla company—that the apex of the east orebody is within the Russell claim, owned by the Federal and under lease to the Marsh—is now down 240 ft. The Federal company has placed a new hoist in position, since taking over the shaft, that is capable of handling the work to the depth of 1000 ft., and has practically re-timbered the shaft and otherwise placed it in a safe and workable condition.

NEVADA

Manhattan.—The annual report of Charles Kirchen, consulting engineer to the Consolidated Spanish Belt, operating near here, estimates the "probable ore" in the mine at 25,000 tons worth $20, and 50,000 tons worth $30. The engineer says work now being done may open another 100,000 tons; 6000 ft. of development work has been done, according to the report. It is expected to have a 50-ton concentrator in operation before the end of August.

Rochester.—One foot of ore assaying $350 per ton in silver, lead, and copper has been opened in the bottom of a 190-ft. winze in the Mayer-Preston lease on the Buck & Charley. The full width of the winze assays $60 and shipments of this grade of ore have been started. Several months ago shipments from drifts at the bottom of this winze reached 300 tons monthly, some of the ore assaying more than $500 per ton for a width of two feet. The ore recently opened was found when sinking of the winze was resumed.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

A. T. Watson is in Peru.

Augustus Locke is in Utah.

D. C. Jackling is at Salt Lake City.

John B. Hastings is at McGill, Nevada.

Nicolas G. Berger, from Bodaibo, Siberia, is here.

Frank C. Loring has returned from London to Toronto.

John W. Mercer, of New York, is at the Fairmont hotel.

E. M. Hamilton has returned from London to San Francisco.

John P. Gray, mining attorney of Coeur d'Alene, Idaho, is in San Francisco.

H. W. Hardinge left for London and the Continent on the 'Aquitania' on July 31.

Percy R. Middleton, on his return from New York, has gone to southern Arizona.

Emmet D. Boyle, mining engineer and Governor of Nevada, is at the Palace hotel.

A. H. Richards has been appointed general superintendent of the Garfield smelter, in Utah.

Ben. B. Thayer, vice-president of the Anaconda Copper Mining Co., is at the Palace hotel.

L. J. Mayreis has renewed his engagement with the Burma Corporation as resident manager in India.

Arthur F. Taggart, of New Haven, now professor in Columbia University, was in San Francisco this week.

F. H. Skeels has been appointed superintendent of the Ramshorn mine of the Ramshorn Mines Co., at Bayhorse, Idaho.

Oscar Osolin, electrical and mechanical engineer for the Lenskoie Gold Mining Co., of Bodaibo, Siberia, is in San Francisco.

R. F. McElvenney, plant manager of the Garfield smelter, has been appointed manager of the A. S. & R. Co.'s lead refinery at Omaha.

Sumner S. Smith has resigned as Mine Inspector for Alaska to take charge of coal mining for the Navy under the Alaskan Engineering Commission.

Robert N. Bell, State Mine Inspector of Idaho, will resign at the end of the year, after 16 years of service, to take up the private practice of engineering at Boise.

Frederick B. Tough, of Colorado, petroleum technologist of the Bureau of Mines, has been appointed supervisor of oil and gas drilling operations under the leasing law.

B. A. Middlemiss, assistant general manager for the Chile Copper Co., is making a visit to the principal mining centres of the United States. He was at Salt Lake City recently.

L. Everett, manager of the McKnight Mining Co.'s mines at Mokelumne Hill, California, is on his way to Colombia, South America, to investigate oil and platinum properties.

Donald D. Riddle and **Roger F. White** have been appointed valuation engineers in the oil and gas section, Income Tax Unit of the Internal Revenue Bureau. **Paul Ruedemann** has resigned.

H. L. Norton, formerly general superintendent for the Arizona Commercial Mining Co., has been transferred to the office of the general manager for the Phelps Dodge Corporation, at Douglas.

THE METAL MARKET

METAL PRICES

San Francisco, August 3

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	19.25
Lead, pig, cents per pound	8.75—9.75
Platinum, pure, per ounce	$105
Platinum, 10% iridium, per ounce	$155
Quicksilver, per flask of 75 lb.	$88
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

August 2.—Copper is inactive but firm. Lead is quiet but very strong. Zinc is dull but easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending		Cents	Pence
July 27	93.25	55.50	June 21		87.07	48.73
" 28	94.25	56.12	" 28		91.41	51.69
" 29	92.25	56.12	July 5		89.97	51.68
" 30	92.62	56.25	" 12		92.18	52.66
" 31	93.37	56.62	" 19		91.04	52.91
Aug 1	Sunday		" 26		93.39	54.77
" 2	91.37	56.62	Aug 2		92.85	56.20

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	....
Mch	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound

Date		Average week ending		
July 27	19.00	June 21		19.00
" 28	19.00	" 28		19.00
" 29	19.00	July 5		19.00
" 30	19.00	" 12		19.00
" 31	19.00	" 19		19.00
Aug 1	Sunday	" 26		19.00
" 2	19.00	Aug 2		19.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	....
Mch	23.50	15.05	18.49	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending		
July 27	9.00	June 21		8.21
" 28	9.00	" 28		8.15
" 29	9.05	July 5		8.39
" 30	9.10	" 12		8.25
" 31	9.10	" 19		8.45
Aug 1	Sunday	" 26		8.93
" 2	9.10	Aug 2		9.06

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.00	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	....
Mch	7.26	5.23	9.02	Sept.	8.05	6.02	....
Apr	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	....
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound

Date		Average week ending		
July 27	8.70	June 21		7.79
" 28	8.15	" 28		7.85
" 29	8.15	July 5		8.04
" 30	8.05	" 12		8.15
" 31	8.05	" 19		8.24
Aug 1	Sunday	" 26		8.22
" 2	8.05	Aug 2		8.11

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	....
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date				
July 6	90.00	July 20		90.00
" 13	85.00	" 27		88.00
		Aug. 3		88.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	....
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	....
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

AMERICAN SMELTING & REFINING CO.

The American Smelting & Refining Co. earned the $2 semi-annual dividend on the common stock by a comfortable margin in the six months ended June 30, 1920, a decided contrast to the corresponding period last year, when only 4c per share was earned and a deficit of $1,195,404 was left after payment of the common dividend. In the final six months of 1919 the net increased to $2.12 per share, and progressive improvement has since been shown, largely due to more favorable conditions in Mexico and better demand for copper.

In the first six months of this year the company made big inroads into its copper accumulation and was able to dispose of 40 to 50% of the metal it was carrying for other companies. How the cash position has been strengthened may be gleaned from the fact that working capital, including metal stocks, stood at $57,680,916 at the close of 1919, against $57,986,518 at the close of 1918, whereas, excluding metal stocks, it fell to $8,919,808 as of December 31, 1919, against $13,946,422 at the end of 1918. Operations of Mexican mines are now approximately 90% of normal. Rapid strides are being made toward completing the unwatering of properties which became flooded during years of disuse, and capacity ore production is expected before the close of the year. The company's five Mexican smelters are now running full blast. With promise of stable governments below the Rio Grande, officials hope for a restoration of normal conditions in Mexico, under which they were able to show net income of $6 per share from Mexican properties alone in former years.

INTERNATIONAL NICKEL CO.

Sentiment among people conversant with affairs of the International Nickel Co. has taken a decided turn for the better. The company is said to have definitely rounded the corner and its business is considerably better than for some time. This condition may be expected to be reflected to some extent in the report for the three months ended with June. While surplus stocks of nickel held abroad and difficulties of transportation in this country materially reduced demand in the fiscal year ended March 31, officials are encouraged by better business since that time. It may be presumed that plant operations are at a higher rate than the 60% capacity averaged during the three months ended March 31; that 60% capacity represented 80% of former capacity, as the Port Colborne plant was included in the percentage for the March quarter.

Not a little of the improvement is the result of new markets the company is constantly developing for its monel metal, an alloy made up of the same component parts as are found in nickel ore. One of the uses for monel metal is in the construction of racing yachts. A large amount was used in the construction of the 'Resolute', as well as in the 'Vanitie'. Another wide use is in golf clubs, where non-rusting qualities are important. The nickel company's financial position was greatly strengthened in the last fiscal year, and at March 31 it had a working capital of nearly $9,500,000 against $9,779,043 on March 31, 1918. The working capital on March 31 last was larger than at any time during the previous three years. Possibility of resuming dividends on the common stock is believed to be somewhat remote, although the company is in a strictly liquid position, with earnings showing real improvement.

MONEY AND EXCHANGE

Foreign quotations on August 3 are as follows:

Sterling, dollars	Cable	3.70⅞
	Demand	3.71⅛
Francs, cents	Cable	7.68
	Demand	7.70
Lire, cents	Demand	5.37
Marks, cents		0.31

Eastern Metal Market

New York, July 28.

Mid-summer dullness pervades all the markets, but prices in most of them are firm. There is a marked disappearance of speculation in copper, lead, and zinc.

Demand for copper continues of moderate proportions and prices are firm.

The tin market is quiet; small transactions are confined to dealers

Pronounced strength characterizes the lead market and prices have advanced.

There is but little life to the zinc market and prices have eased slightly.

Antimony has declined somewhat.

IRON AND STEEL

Steel works in the Pittsburgh district will soon be forced to a further lessening of output because of the railroad situation unless unexpected relief is soon afforded. Developments at Chicago have been unfavorable because of the strike of the coal miners of the State. Five more blast-furnaces have been banked there, so that the Steel Corporation has only 14 in blast out of a total of 29 in that district.

Steel producers from Pittsburgh and Youngstown have gone to Washington to obtain relief, because they state that the threatened coal famine in the North-West and the grain movement in the West are diverting an excessive number of cars.

Generally speaking, new inquiry on finished products has decreased. Reports from the automobile trade are conflicting. Indications are that there is a letting-up because of the smaller operations by manufacturers of axles, springs, and other parts. Demand for trucks has fallen off, because the financial situation is causing users to cease buying or to cancel orders.

COPPER

Business from both domestic and foreign consumers continues of moderate proportions. Prices are firm at 19c., New York, for both Lake and electrolytic copper from the large producers. From small producers and particularly from dealers the supply is light and only small quantities are available around 18.75c., New York, for early delivery. Leading interests are selling for August-September delivery at 19c. and some are asking 19.25c. for delivery in the last quarter. An encouraging sign is that demand from consumers for shipment on contract is better and also that shipments from refineries are easier. The June production of smelters was about 115,000,000 lb. by 20 representative operators, which made about 650,000,000 lb. in the first half. Copper exports thus far this year have been only a little less than the rate which was a record in 1913.

TIN

Conditions are but slightly changed and the market continues quiet. There is no demand from consumers who have been out of the market now for some weeks. It is even said that one large consumer was offering October shipment metal, but this is not confirmed. Last Thursday low prices were quoted for future shipment at 48.25c. The spot Straits market is nominal with the quotation yesterday at 48.50c., New York. Metal for this position continues hard to obtain. In the week, sales on the New York Metal Exchange have been small, one of 25 tons of July-shipment Straits going at 48c. last Thursday and 25 tons of August-September on Monday at 49c. The London market is quiet with spot Straits quoted at £282 per ton yesterday against £288 a week ago. For spot standard tin the quotation was £267 and for future standard it was £271. Arrivals thus far this month have been 3385 tons, of which 720 tons is credited to Pacific ports. The quantity afloat is 4715 tons.

LEAD

The American Smelting & Refining Co. last Wednesday, July 21, advanced its price ½c. per pound to 8c., St. Louis, or 8.50c., New York, thus recognizing the strength of the market, which continues to expand. But this price is still considerably below the outside market, which yesterday was quoted at 8.75c., St. Louis, or 9c., New York, at which level sales have been made. This situation is due to continued good demand in spite of high prices and to limited output, which is stated to be about 60% of normal. Prompt-shipment lead from the West has sold at 9c., New York, at which level it is scarce. It is believed that August lead cannot be had at less than 9c., New York, and perhaps September lead, also, at no better price. There is no question but that import lead will soon appear in this market, as it is reported already on the way.

ZINC

Conditions in this market do not improve greatly and business is of the hand-to-mouth order and light at that. Galvanizers and brass-makers are buying only as they need it, due either to light business or large stocks. Producers are unwilling to sell beyond September, so uncertain are they of the future. Ore is high and present zinc prices do not net much profit. What the situation as regards labor and ore will be in the fall, no one can tell, and hence the conservatism. Prime Western for July, August, and September delivery is quoted at 7.85c., St. Louis, or 8.20c., New York.

ANTIMONY

Heavy stocks and offers of shipment at prices about equal to the ruling spot price have caused an easier tendency. Wholesale lots for early delivery are quoted at $7.25, New York, duty paid.

ALUMINUM

Wholesale lots of virgin metal, 98 to 99% pure, are quoted at 33c., New York, by the leading interest and at 31.50c. by other sellers, both for early delivery.

ORES

Tungsten: The general situation is unchanged. Demand is light and prices are nominally unchanged at $6 and upward per unit, depending on the grade and the delivery.

Ferro-tungsten is quoted at 80c. to $1.10 per pound of contained tungsten.

Molybdenum: Quotations are nominal at 65c. to 75c. per pound of MoS_2 in regular concentrate and the market is devoid of features.

Manganese: There have been offerings of Indian ore at 75c. per unit, but no sales, as most users are unwilling to pay more than 70 cents.

Manganese-Iron Alloys: The ferro-manganese market is quiet with inquiries light and sales confined to small lots for early delivery. Quotations are unchanged at $225 per ton, delivered, for early delivery and $200 for forward delivery. The spiegeleisen market is strong and unchanged at $75, furnace, with one inquiry for 600 tons before sellers.

The production of silver in Mexico has averaged in recent months about 6,500,000 ounces.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

LIGHTING DRAFTING-ROOMS BY ELECTRICITY

Modern methods of lighting drafting-rooms are discussed in Bulletin L. D. 108, recently issued by the Edison Lamp Works of the General Electric Company.

There are now three methods generally accepted of supplying light, known as direct, semi-indirect, and totally indirect. With direct lighting a reflector is placed above the lamp, or an enclosing globe around it, sending the larger part of the light at once to the desk level. A semi-indirect unit consists of a translucent dish, bowl, or reflector placed below the lamp, sending most of the light to the ceiling, from which it is reflected downward, but allowing part of the light to be diffused through the glass. A totally indirect unit consists of an opaque reflector below the lamp, sending all of the light to the ceiling.

Direct lighting with efficient reflectors is unquestionably the most economical, as far as current consumption is concerned, of the three methods, for with it the color of walls and ceilings have less effect on the resultant illumination. Direct lighting, if improperly arranged, may produce glare either from the light sources themselves or by reflection from the objects lighted, or it may distribute the light unevenly and as a result produce dense shadows. Nevertheless, thousands of satisfactory installations of good direct office-lighting are to be seen, employing translucent glassware rather than opaque reflectors, thus avoiding the undesirable condition of a dark ceiling and the gloomy appearance of the room. Many forms of semi-enclosing glassware of the direct type are giving very satisfactory service.

Totally indirect lighting is probably the most 'fool-proof' from the standpoint of a glaring installation. The light is usually evenly distributed and comfortable. Objections have been raised that there is a total absence of shadow, making the room appear flat. If the system is properly designed, however, this is not true.

Semi-indirect lighting is an intermediate practice; it is more efficient than totally indirect and much better for the eye than the average direct-lighting system. Semi-indirect lighting is not glaring if the proper unit is chosen; the light is quite evenly distributed and such shadows as are produced are very soft and do not become annoying. The fact that the place where the light originates is readily discernible, has a psychological effect on the average individual, and makes many people feel more at ease under semi-indirect lighting than under totally indirect.

A semi-indirect unit, first, should be of quite dense glass; in other words, transmit but a small portion of the light, if the best conditions for the eye are to be obtained. If light density glass is used, the bowl becomes very bright and the system loses many of its advantages, dropping back to the direct-lighting class where a number of fairly bright objects are in the field of vision. Second, the fixture or hanger used should be of such a length and the socket in the proper relative position to the bowl that the light is directed in such a manner as to illuminate the ceiling evenly. Many cases can be noted where the lamp is placed too low in the dish, concentrating the emitted light in a fairly narrow angle, resulting in a ring or circle of very bright illumination on the ceiling directly above the unit with the spaces between units comparatively dark. At other times to get rid of this effect, the lamp is raised so high that from some parts of the room the filament becomes visible, introducing glare. On the introduction of the Mazda C lamp, with its rather concentrated filament, this feature became of more importance than formerly. Third, the glass used should be smooth inside and, preferably, outside, as roughed glass collects dirt very readily and is difficult to clean. Needless to say, all lighting fixtures should be regularly and carefully cleaned to keep the illuminating-efficiency at a maximum.

Although the lighting requirements of the drafting-room are somewhat exacting, they may be readily met if due care be taken in the selection and placing of lighting units. The ideal condition is an even distribution of well-diffused light of a high intensity. Shadows must be minimized, as they make it difficult to follow the fine lines when working close to the T-square or triangle. A high intensity of illumination is necessary. Five foot-candles is the minimum and should be supplied only for rough work. For the most exacting work, such as tracing from blue-prints, from 10 to 20 foot-candles will be required.

Semi-indirect systems where dense glass is employed, or totally indirect systems are probably the best suited, using from 1.5 to 3.5 watts per square foot. Direct general illumination of a high intensity using rather close-spaced semi-enclosing units is also used, where the ceilings are so dark as to preclude the use of indirect systems, and found satisfactory. The units should be located with reference to the drawing-tables and so arranged that the maximum light will come from the proper direction. Lamps must be hung well out of the angle of vision and every effort made to avoid glare. In both the direct and semi-indirect systems of illumination due note must be taken of the usual arrangement of boards relative to the windows, placing the lamps so that, as far as possible, the direction of predominant light is the same as that of daylight.

A system which is quite frequently found is the use of a diffused general illumination (1 to 2 foot-candles) supplemented by a local lamp for each drawing-board. This unit may be of several varieties, fixed or movable, attached to the wall or to the drawing-board, opaque or diffusing reflector, and various sizes of lamps; but in any case it is open to the usual objections of local lamps, namely, liability of glaring reflections, loss of time in shifting the lamps, and relatively high maintenance cost. Tracing may often be satisfactorily accomplished by having the top of the tracing table made of etched glass, and lamps with suitable reflectors placed below the glass, illuminating the work from beneath rather than from above.

NEW BOOKLET ON MODERN METHODS OF BELT-JOINING

Both the man who buys belting today and the man who has an investment in belting have a commodity which can only be replaced with delay, difficulty, and considerable expense, and the continuous performance of which is essential for maintenance of production schedules and operating at

minimum cost. One of the biggest problems the belt-user has to face is that of joining the belt in a way which preserves its strength and ensures its longest and most satisfactory service. Obviously, no belt can give better service than its joint will permit, and if destructive methods are employed which punch out valuable material or weaken the lengwise power-carrying belt-fibres the service and the life of the belt are impaired. A new booklet entitled 'Modern Scientific Methods in Belt Joining' contains practical belt-joining data for the practical man. This information is of permanent value to anyone interested in the upkeep of belts and the book is so designed that when it is tacked to a wall it presents on one page full information for joining the belt to ensure its best service under all conditions of work. The instructions as to how to make belt joints which retain the belt's full strength and assure its longest life are given in simple and concise language and are amply illustrated. The larger illustrations show in full size the outside and pulley sides of Crescent joints. A cross-section illustration shows how a belt can be joined without weakening it in any way, and is a vivid demonstration of how the Crescent method retains the full strength of the belt and actually reinforces it. It also shows how the Crescent method prevents metal coming in contact with the pulley and thereby eliminates noise, wear, and crystallization. Copies of this illustrated circular, form N. Y. 227, will be sent upon request by the Crescent Belt Fastener Co., 381 Fourth avenue, New York.

NEW TYPE OF SHIP COMPLETED BY BETHLEHEM STEEL CORPORATION

The diesel-driven ore-steamer 'Cubore' has completed successfully her trial trip and will start on her first voyage to Cuba this week. The 'Cubore' is propelled by a Bethlehem two-cycle diesel oil-engine of 3200 hp., designed by Arthur West, one of the foremost gas-engine engineers in the United States and the designer of the largest and most successful gas-engine in the world. This ship represents the greatest single advance in marine engineering in fifteen years. Its heavy-oil engine, designed by an American, built by Americans, for use in an American ship, represents this country's first successful attempt in a field that has been held exclusively by foreign interests. The 'Cubore' will be used in carrying ore from the Bethlehem Steel Corporation's Cuban properties to the Bethlehem plants in the United States. The following are special features of the vessel:

Length overall, 469 ft.; length between perpendiculars, 450 ft.; breadth, molded, 57 ft.; depth, molded, to upper deck, 37 ft.; dead weight, about 11,500 tons; number of screws, one; revolutions, 105 per min.; type of boiler, Scotch; number of boilers, one; steam pressure, 140 lb.; heating surface, 1800 square feet.

REINFORCED-CONCRETE HIGHWAYS

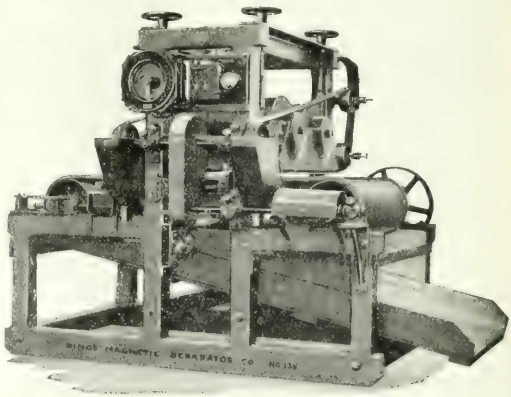
A recent leaflet from the American Steel & Wire Co. says: "Steel and concrete have about the same ratio of expansion hence readily become as one integral mass. The great strength of steel is therefore imparted to every inch of the concrete in above manner. A concrete tower, or building, or sidewalk, or bridge, or ship, is invariably reinforced with steel fabric. A concrete highway has to stand more than either in that in addition to rending impact of heavy traffic it has to endure the tremendous heaving force of frosts that lift up the sides of the road as the first freezing occurs in the fall, lowering with the spring thaw, thus causing the long sprawling cracks lengthwise, mainly, of the road. But these cracks do not harm the concrete if bound together with steel as shown above, while the reinforcement greatly lessens the liability of the cracking.

"It is possible to reinforce concrete so strongly as to avoid any possibility of cracking, but the cost of such construction makes it necessary to limit the steel to a certain adequate medium to fit the money available; and for the same reason the thickness of the concrete must be limited. But the concrete and the steel must go together—not one without the other. The steel must be evenly distributed throughout a concrete road to reinforce not only in one direction but in all possible directions to meet the crushing and abrasive forces of sudden and heavy loads imposed by a necessarily ever-increasing heavy traffic, and also the frost-stresses above described and the effects of washouts.

"For these reasons a concrete highway distinctly has a greater burden to bear than the tower, the building, sidewalk, bridge, or ship and hence a more urgent need of being adequately reinforced with steel. These points are, of course, admitted. It is simply a question of the amount of money available for the work. It prompts this suggestion—how much will it cost to make a mistake and have to build all over again?"

THE DINGS MAGNETIC SEPARATOR FOR WET CONCENTRATION

The Dings magnetic separator, type "BW", has recently been developed for concentrating wet ore. It is built upon a combination of the Wetherill and Dings principles. The pulp is fed upon a vanner belt which conveys it under the two magnetic poles. The magnetic material attracted to the poles is removed by the two cross-belts, and the non-magnetic material is discharged over the drive-pulley into the launder beneath.



Dings Magnetic Separator

The standard Wetherill machine has coils both above and below the belt. The lower coil would be water-soaked in a short time if used on a wet machine. A Dings bridge bar has been substituted for the lower Wetherill coil, completing magnetic circuit. The cross-belts, which remove the magnetic material, must be placed above the surface of the pulp; consequently a very large magnetic gap is required. The inverse law of magnetism and the wide gap necessitate a high-intensity field to attract the magnetic particles of ore in the pulp. There is a distinct agitating action caused by the magnetic flux in the pulp underneath the poles. This zone of agitation is of assistance in thoroughly washing and cleaning the magnetic particles and freeing them from any attached non-magnetic material. It also permits the machine to run faster than a standard dry machine for the same separation, and has for that reason a higher capacity.

One of the difficulties in dry magnetic separation has been the clinging of fine particles to the belt, and material finer than 100 mesh was difficult to separate cleanly. This wet-type machine is making a high-grade zinc concentrate from

ore ground so that 60% passes a 200-mesh screen. The consistence of the pulp is about one of solid to four of water. It has a capacity of 100 tons per 24 hours on a 48-in. belt. One of the main objections to magnetic separation is the dust and dirt from handling dry material as well as the cost of drying. This machine removes this objection and can be used with other wet-concentrating machines.

The coils of this machine are thoroughly impregnated by vacuum and pressure, and then encased, making them water-proof. The current can be varied by a large rheostat, and the poles may be raised or lowered independently to give any width of gap desired. The power required to drive and to energize the coils is small. The machine is sold outright, there being no royalty. It is made in five sizes with belt widths from 18 to 60 inches.

THE TRAYLOR SUPERPUMP

A recent development in pump manufacture is the superpump made by the Traylor Engineering & Manufacturing Co.

That the power-driven pump is the most efficient and most economical machine for the handling of liquids is an incontestable fact. This is true for the reason that the stroke is a fixed and known quantity thereby yielding a measured displacement for each revolution. A further reason is that a much higher piston speed may be had with a crank-pump than with a direct-acting steam-pump. It is, however, no simple matter to build an efficient power-pump, due to the fact that problems are presented which are not found in the design of a direct-acting steam-pump. The chief of these are:

First: The piston speed of a plunger-pump varies throughout the stroke, inasmuch as the crank describes a circle while the plunger moves in a straight line. It will thus be seen that the velocity of the plunger increases from zero to maximum and then decreases from maximum to zero.

Second: Water is practically incompressible and therefore the velocity of the discharge is at all times in direct proportion to the speed of the plunger.

Consideration of these points will show that the pump-chambers and the pipe-line are subject to shocks or pulsations depending in severity upon the speed and pressure. This does not occur in steam-pumps. As a consequence, simplex and duplex power-pumps have little advantage over direct-acting steam-pumps, notwithstanding the wastefulness and low efficiency of the latter. It is clear, then, that the solution lies in the multiplication of plungers, and when three or five are used, the power-pump rises superior in efficiency and economy. The reason is, of course, that the cranks being set equal distances apart (120° in the triplex or three plunger, and 72° in the quintuplex or five plunger), the pulsations overlap, so that the discharge from the pump-chambers is nearly uniform in quantity and pressure.

The Superpump is a machine of simple and sturdy ruggedness. The design is heavy, the use of metal lavish—to minimize vibration and forestall fracture. The water passages are large and free from angles; valves are ample in area and bearing pressures are low. The pump is simple to operate and easy to maintain and the delivery is steady and reliable. An especially valuable characteristic of the Superpump is its very economical use of power; it pays its way easily and leaves a margin for substantial profits.

All these advantages combine to make the Superpump the most efficient, economical, and dependable pump purchasable. In a pump, initial cost is negligible when operating and upkeep expenses are held down to the minimum and here is where the Superpump excels.

The Superpump is a vertical, single-acting, outside-packed plunger-pump—the pattern which all engineers agree is the most compact, durable, and efficient. The design offers the following advantages:

1. It is the only pump which will successfully handle gritty or acid water.

2. Leakage is noticed as soon as it occurs and packing can be adjusted without stopping the machine.

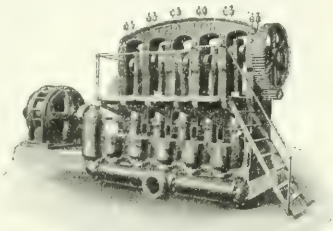
3. Lubrication of any part can be accomplished during operation.

4. The pump is single-acting, so that all the working thrust is always in one direction, minimizing wear and vibration.

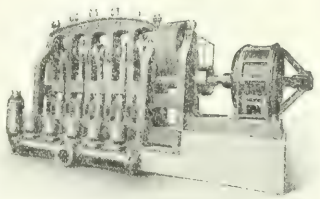
5. All strains are taken on finished bolts, eliminating loose joints and consequent packing.

6. The machine is highly sectionalized, which cuts down repair bills. As every part is easily accessible, only the single inexpensive part directly affected need be removed. Also, by this construction, pumps of large size may be taken to, and erected in, places that would otherwise be inaccessible.

Some details of the construction of the pumps, two types



Type D, Quintuplex Superpump. Drive 102



Type DD, Quintuplex Superpump. Drive 100

of which are shown in the accompanying illustrations, are of special interest.

The crankshaft is the single piece, which is conceded by all users to be superior to the composite or built-up type, by reason of its greater resistance to deflection. Our crankshafts are made of the highest grade open-hearth steel, cast on end, and designed for a strength of sixteen to twenty times the plunger load. The connecting-rods are the adjusting type with forged steel strap, cast-steel stub and bronze bearings, correctly grooved for proper lubrication. A wedge and screw is provided on the crank end, by means of which micrometer adjustment may be had. On rods with crank-pins five inches and less the wedge is under the bearing while on larger sizes it is on top. A cradle of semi-steel is securely bolted between the standards and is bored out for the crossheads or for crosshead-ways. Usually the cradle is fitted with ways or guides for the crossheads to work in. The ways are generally made of cast-iron, but in special cases may be of bronze. They are turned to fit the cradles and bored for the crossheads.

The crossheads are made of hard close-grained cast-iron

carefully turned and polished to fit the ways. They are made of such size that the pressure on the ways does not exceed 45 lb. per square inch. In some cases, the crossheads are fitted with adjustable shoes, the cradle being then merely bored out for the crossheads. Such shoes may be of cast-iron or bronze and are adjusted by means of setscrews. Adjustment is on an inclined plane, thus keeping the crosshead-pins in the centre of the guides and securing even distribution of the load.

Each working barrel is a separate casting, either bolted between standards or to adjacent barrels. Liberal flanges are provided for attachment of valve-chambers. In some cases the working barrel and valve-chambers are made in one casting. The working barrel is made of cylindrical shape, which is the strongest form. For pressures to and including 750 lb. working barrels are made of semi-steel; between 750 lb. and 2000 lb. open-hearth cast-steel is employed, while above 2000 lb. they are of forged steel, worked out of the solid. Attachment of barrels to each other or to the standards is by means of turned bolts. The stuffing-boxes are of extra depth to minimize friction and prevent leakage. High-grade waterproof packing, suitable for the service demanded in each instance, is provided. The packing is adjusted by glands, made of semi-steel, or cast-steel, as required. They are held in position by hinge-bolts or studs, according to the construction of the pump. The plungers are made of hard close-grained cast-iron, chilled iron, or forged steel as the service demands. All plungers are machined and ground to exact size and perfect finish. Plungers are securely attached to the crossheads and can be easily removed. The valves are the most important part of the pump and they are therefore accorded particular attention. The valves in every Superpump are specially designed for the particular service contemplated and may be single or multiple, of the disc type with grid or annular seats, or, in the case of heavy liquids or those carrying solid particles, of the ball type. In the disc type, the seats, plates, and stems are made of bronze of high tensile strength and phosphor-bronze springs are used. The disc-valves have renewable faces of fibre, rubber, or leather, depending on the service. Ball-valves may be steel, bronze, or rubber-covered iron, with bronze or steel seats. Valve-seats are turned on a taper outside to facilitate insertion or removal from the decks in the valve-chambers. All valve-openings are designed for a water-velocity not exceeding three feet per second. Special attention is given to the question of lubricating all parts of the Superpump. The means range from the ample grease and oil-cups of ordinary requirements to elaborate force-feed systems actuated by the crankshaft for large heavy-duty units.

EMPLOYEES OF THE MINNEAPOLIS STEEL & MACHINERY CO. CELEBRATE THE NATION'S BIRTHDAY

The accompanying illustration shows an assemblage of skilled craftsmen listening to the reading of one of the imperishable documents that embody the spirit of Americanism. They are the men who operate the big plant of the Minneapolis Steel & Machinery Co., gathered for a patriotic program in anticipation of Independence Day. Only a small part of the audience could be included in the camera's focus, but these men are representative of the whole. This picture is characteristic of the company's organization. There are few enterprises of its size in the country which boasts of more friendly relations, not only between employer and employee, but among the men themselves. Interdepartment friendships are cemented by summer kitten-ball leagues and an all-winter bowling league, picnics, and dances at the Minneapolis Steel Club, and the men are encouraged to take a personal interest in the company's welfare.

COMMERCIAL PARAGRAPHS

After August 1 the office of H. W. Clarke, manager of the publicity department of the **Chicago Pneumatic Tool Co.**, will be in the Chicago Pneumatic building, 6 East 44th St., New York City.

The General Engineering Co., of Salt Lake City, has been retained by the Utah Consolidated Mining Co. to design and erect the 1000-ton flotation-plant that the mining company is building at Tooele, Utah.

Bulletin 504, recently issued by the **Chicago Pneumatic Tool Co.**, 6 E. 44th St., New York, describing its Slogger rock-drill, is now available, upon request, from its New York office or any of its branches.

On August 1 the **Denver Rock Drill Manufacturing Co.** opened a new branch office at 421 Manhattan Bdg., Duluth, to facilitate the handling of its business in the Minnesota and Michigan districts. The new office will be an added convenience to the company's customers.

The Republic Belting Co., of Baltimore, has acquired a site covering a full city block for the erection of its new plant. Mr. Haldreich Egli has been retained to direct the construction work, which is to be commenced at once. Charles H. Dankmeyer, president of the company, has been engaged in the belt-manufacturing business for many years and his organization will include experienced men in their particular line.

The Buffalo Forge Co. has issued catalogue No. 700 on 'Fan Systems of Heating and Ventilating'. The company has always taken the stand that engineering data and developments should not be hoarded as hidden treasures but should be made available for the use of the engineering profession in general. In this volume it has laid stress on the principles underlying all the various steps in the determination of suitable apparatus to meet all conditions of heating, ventilating, and humidifying. These principles have been proved by actual practice and are the ones used by its own engineers in the solution of problems of a similar nature. This is a most valuable publication for the ventilating engineer as a reference work dealing with the principles of ventilation and the most modern equipment.

D. D. Tripp, vice-president of the **Pioneer Rubber Mills**, returned some time ago from a five-months journey in the Orient. He says that his trip proved resultful in the actual contracts secured, in the new agencies opened for the Pioneer Rubber Mills, and especially in the intimate insight he had obtained into conditions in the Orient. His company is making adequate plans to take care of its increased domestic and foreign business and, to this end, has materially enlarged the capacity of its plant at Pittsburg, California. One of the largest and most modern belt-presses in the United States was recently installed at the plant. It is indicative of the progress made by this Pacific Coast institution, not only in broadening its market but in taking good quality-care of its business at home.

T. A. RICKARD, - - - - Editor

TANGIBLE evidence of the unfortunate result of the steadily increasing cost of producing gold is found in the recent action of the Tonopah Belmont Development Company in suspending all operations except pumping at its Shawmut mine in the Mother Lode region of California. Last January the ore-reserve in this mine was reported to be 429,098 tons, so the reason for the action of the directors is obvious.

BENDIGO was once a name to conjure with, but that was long ago. Like other mining communities born in the golden age of Californian and Australian discovery, its glory has grown dim; yet it remains an important and attractive town, thanks in part to a prosperous agricultural industry. The golden grain on the surface now brings more riches than the harvest of gold underground. Even this is not ended. We learn, from an Australian paper, that on May 26 a shipment of remarkable ore was made from the Constellation mine, belonging to the Bendigo Amalgamated Goldfields. It is reported that 365 tons broken on the 622-ft. level yielded 1465½ ounces of gold. Since the 'reef' was found 18 months ago a profit of £100,000 has been made. The 'reef', of course, is not like anything the term suggests, but a 'saddle', an anticlinal structure of gold-bearing quartz following an arching fold in the slate and sandstone beds of the Lower Silurian sediments. In 1853 Bendigo yielded 661,729 ounces of gold, worth about $13,250,000. Altogether Bendigo's output is estimated at $325,000,000. In 1917 it contributed 66,000 ounces.

WE have received a copy of a prospectus in which is described a new kind of ore deposit. It consists of "a lime-quartz dike or belt several thousand feet wide". Of course, it is of no importance whether the width be two or twenty thousand feet. It has "a very peculiar asbestos grain or texture". It must be peculiar indeed. "Almost the whole of this dike carries values in gold and silver with occasional carbonates of lead." For our part we prefer the "carbonates", which are specific, even if "occasional", to the "values", which are nebulous. What is or are 'values' anyway, for the love of Pete? The prospectus quotes no assay; it gives no average contents; it expatiates only in terms of 'values'. "Occasional lenses of this asbestos character", we are informed, "carries very high gold values, the lead being disseminated almost entirely". Why not? What's to hinder? We quote *verbatim et literatim*. Apparently "the character carries very high gold values", which is reasonable, for one abstraction may well be contained within another; it is more reasonable than putting a concrete idea within one that is abstract. That would be dyspeptic to any real philosopher. Shades of Metalliferous Murphy! how he would love the lead that is "dissiminated entoirely". "The geological formation shows very deep and lasting bodies of ore values". A body of "ore values" resembles the limited liability companies, of which it has been said that they had no souls to save and no bodies to be kicked, and thus were free in this world and the next from all the effective sanctions of conscientious conduct. People who talk about exploiting "ore values" in a lime-quartz dike, or any other geologic abortion, enjoy the sensation of thought without the trouble of thinking.

GOVERNOR COX, in his speech of acceptance as the Democratic nominee for the Presidency, strikes a note that is more natural, and therefore more interesting, than that of his opponent. Indeed if speech-making be the main test of fitness for the most responsible office in the world, Senator Harding is disqualified. Both candidates take much the same stand on the various issues, except the League of Nations. On that they cross swords unmistakably. It is a great and vital question, and we are not sorry to see it made the chief issue of the political campaign that is now formally started. A separate peace with Germany is unthinkable, for it would dishonor us as a nation and involve us in complexities worse even than those that face us now owing to our refusal to ratify the peace that has been made by our Allies, or Associates. That the League should be used only for maintaining peace and that our participation must be within the terms of the Constitution are 'interpretations' in which every citizen can well afford to join with Mr. Cox. We agree with him that "we are in a time which calls for straight thinking, straight talking, and straight acting", in short, we must be true to our traditions—those handed down to us through Washington, Lincoln, and Roosevelt.

UNDER the caption 'An Inside View of Wall Street' we are told, in the 'Boston News Bureau', that "the Harding letter of acceptance is the most forceful document of its kind that voters have read in recent years".

This is true only if voters do not make a habit of reading such 'documents'. But we can understand that it pleased certain people on Wall Street and State Street. Harding promises, from their point of view, to be 'good'. Editorially the same useful financial paper says: "The art of clear and graphic statement is one of the marks of a leader of the people". This introduces sundry favorable remarks upon Mr. Coolidge's letter of acceptance, which certainly was vastly superior to that of his colleague, but even so is nothing to brag about. Why in thunder do not these gentlemen talk plain English and avoid their foolish efforts to be impressive not by clear thinking but by a stilted magniloquence. Front porches seem to be more demoralizing than pulpits and almost as debilitating as soap-boxes. Our Boston contemporary says that Mr. Coolidge's speech is "a powerful, but characteristic, complement to the longer, more detailed and argumentative utterance of Harding". It is astonishing how the faculty of criticism is benumbed by partisanship, and how clever people like Mr. C. W. Barron, of the 'News Bureau', are not content to fool themselves but expect to extend the process to others. Most of the time they succeed with most people.

SOMEBODY has sent us the prospectus of the Broken Hills Silver Corporation, together with a letter mailed to him by George Graham Rice. Our correspondent has taken care to remain anonymous, by cutting out the place where his name and address had been written. Evidently he assumes that we shall show more moral courage than himself. His assumption is fully warranted. Whether the mine under option to the aforesaid corporation is valuable or not, we do not know. The report by Mr. A. P. Thompson is not convincing. There is too much geologic guff; the quantity of it is wholly disproportioned to the number of assays quoted or the amount of real information conveyed. Mr. Thompson says that the property lies in "a region of profound volcanic disturbances", although most of his remarks deal with surficial lava and "cap rock". There is too much pseudo-scientific stuff, such as: "East of this strata [stratum, if you please, but even that is not the word for a flow of andesite] of silver-bearing silicious andesite, more basic andesite flows cover the surface. While there is no evidence either on the surface or underground in the mine to definitely fix the age of this andesite relative to the more acidic rock, in which most of the veins and ores [are the 'ores' detached from the 'veins'?] occur, it is possible that beneath this basic andesite the more prolific mineral-bearing acidic flows will be found." This reads like a front-porch speech by a politician trying to avoid saying anything by talking a great deal. Mr. Thompson says that "vein-matter which does not contain 100 ounces silver per ton or over is left in the workings and used as a floor". What magnificently negligent persons the present owners must be! He cites the assay of a sample here and there, but he does not quote the results of systematic sampling, although he appears to have taken some of his samples "at intervals of ten feet". In approved front-porch manner he makes the sapient remark: "In the course of stoping the ore it will be convenient and highly desirable to sort out the barren rock from the ore in the stopes after it is broken and before the ore is hoisted to the surface." Who would have thought it! He finds $101,375 of ore blocked out, with various possibilities and potentialities, some of which are not unreasonable in an area so well fissured and mineralized, but this prospect is capitalized for 3,000,000 shares of 10 cents each, of which 2,000,000 shares have been underwritten by the Fidelity Finance and Funding Company of Nevada "to net the Broken Hills Silver Corporation $380,000". This sounds grand; but it is only another name for Rice, *alias* Herzig, who signs the letter as Treasurer and whose nefarious doings have been exposed time and again. He calls attention to a copy of "a commendatory letter from the Chief Executive of the State of Nevada, which appears on page two of the circular". Now, Mr. Emmet D. Boyle is a mining engineer and a first-rate man in other respects, but it is fair to ask why he allowed his name to be used by such a man as Rice, whose career as a fake promoter is notorious. Moreover, we venture to say that for gentlemen labeled as "The Treasurer of the State of Nevada" and "The State Bank Examiner of Nevada" to use the prestige of their public office to boost a promotion by Rice is a scandal. In any event, we are surprised at Mr. Boyle. He gives his opinion of the mine after an examination that he describes as "necessarily cursory". He might do this as Governor of Nevada, but he ought not to do it as an honorable member of the mining profession.

COPPER in the form of large masses of native metal is found in the amygdaloid lodes of the Lake Superior region. Our correspondent at Houghton records the fact that a mass weighing 24 tons was hoisted recently through the No. 2 shaft of the old Quincy mine. Last year 1290 tons of 'mass' copper was hoisted through this same shaft. The latest, weighing 24 tons, was 8 feet long, 4 feet wide, and 4 feet thick—in other words, just the size of a cord of firewood. In order to get it into the skip it had to be cut into three pieces by means of an acetylene torch. In the old days the cutting would have been done by means of chisels and hammers. The largest mass of copper on record was the one found in the Minesota (with one 'n') mine, in the Ontonagon district of Michigan, in 1857. Its extreme dimensions were 46 feet long, 18½ feet wide, and 8½ feet thick, that is, as much as 60 cords of wood. It weighed 420 tons, which suggests that it was ragged in shape and that the extreme dimensions do not indicate correctly its real bulk. Attempts to break it by blasting failed ridiculously, as might be supposed. Then 20 men labored with cape chisels (having a ¾-inch bit) and sledge-hammers for 15 months; the cutting yielded 27 tons of chips. The cost of cutting was $12 per square foot. In later days the pneumatic hammer has been used successfully, at about a quarter of the cost of the old-fashioned method. We shall endeavor to ascertain the cost when the acetylene torch is used for the purpose, as mentioned above. The latest mass was unearthed on the 82nd level of the Quincy. As the shaft

follows the dip, which flattens from 50° at surface to 37° in the lower workings, the 82nd level must be about 5000 feet deep. It is an interesting fact, but not discordant with scientific expectations, that native copper in large lumps should be found a mile below the surface.

The Examination of Mines

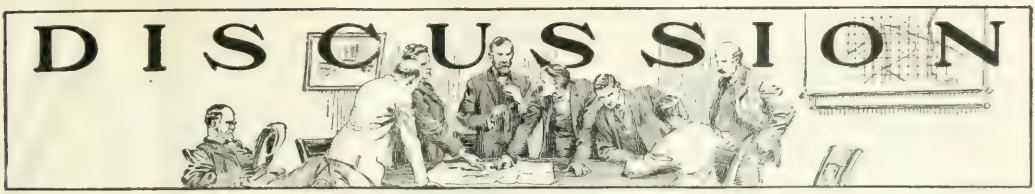
In this issue we publish another of the series of articles by Mr. Morton Webber upon the sampling and valuation of mines. This time he describes the system he himself uses when engaged in the task of appraising a large mine. Of course, his methods are not unique; in large measure they resemble those of other experienced mining engineers, but the description of the plan he adopts will pique the curiosity of his peers and should prove highly interesting and useful to the younger members of the profession. It is proverbially difficult to teach new tricks to an old dog; probably Mr. Webber's contemporaries will prefer their own way of attacking such a problem as the one described in his article, but his juniors will be grateful for this frank and detailed account of the practice followed by a successful senior in their profession. After all, the generalized statements and roundabout ratiocinations to which many writers limit themselves may have a vague literary charm, but such a frankly egoistic account as Mr. Webber's brings the engineer face to face with realities; it gives first-hand facts in a way that the practitioner in the field, rather than the student in the library, will be glad to use to his own benefit.

It will be noted that Mr. Webber is willing to avail himself of the assistance of the geologist, but he has a decided opinion concerning the limitations of the latter as an appraiser of mines. We are in accord. Some, but not many, geologists have had the training of a mining engineer, the best of which is the actual management of mines, but commonly they lack the qualifications for valuing mines, and many are the sad stories of those unaware or careless of such qualifications. The geologist naturally is as strong on the scientific side as he is weak on the commercial; he knows the value of geologic criteria much better than he appreciates the incidence of economic conditions upon the profitable exploitation of an ore deposit. Mr. Webber shows good judgment in recognizing the proper province of the geologist and the unwisdom of a mining engineer on his part attempting to elucidate geologic relations vital to the future of a mining enterprise without the aid of a specialist in that subject. Next Mr. Webber lays emphasis on the fact that wise men do not buy mines for their ore-reserves—they do not buy ore—but in the expectation of an expansion of the enterprise through the finding of more ore, in depth or laterally; they hope to do better than the previous owner by the application of more skill, in management, in mining, or in metallurgy, than the other fellow could command; or by the lowering of the cost of winning the metal by increasing the tonnage treated, either by additions to plant, by more extensive development, or both. In plain English, the buyer expects to do better than the seller; it is a speculation, based upon technical data plus luck, for a man who goes into mining without casting a kindly eye at a billiken or some other fetish of good fortune does not know the proper spirit of the adventure. An adventure it was and ever will be, from Colchis to Chuquicamata. In starting an examination one has to deal with men as well as samples. Mr. Webber touches upon the amenities of the business. He who does not understand his fellow-men is likely to make blunders, or, at least, to lose many opportunities for obtaining hints that are worth as much as a thousand assays. The object of an examination is to value the mine, of course, but to do that comfortably it is also desirable to understand the vendor's standpoint and to ascertain why he is selling. In other words, the canny engineer will look around for the nigger in the wood-pile, for any condition that while explaining the motive for the sale thereby gives a reason for not buying. That applies especially to high-grade mines and to those that have been too little tested by metallurgical results. In the days of our forefathers it was customary to depend less upon sampling and assaying, and more upon other kinds of evidence of an unsystematic character. The graduate from a mining school today has been taught how to sample and survey, how to map and estimate, he has heard of amortization and Inwood's tables, but with all his meticulous methods he may fail lamentably in recognizing the real character of the mining venture on which he is asked to express an opinion. His grandfather, if in the same profession, would have looked over the records of the mine, examined the maps, gone underground, broken a sample here and there, recognized the critical headings, and put his finger on the vital spot. He did it unsystematically, partly by sheer native intelligence, partly by a knowledge based upon experience, sometimes by a stroke of luck. At other times, he failed lamentably in his appraisal, just as his much better trained grandson. A good judgment on a mine, or on anything, requires the ascertainment of facts, the elimination of the non-essential, the concentration of thought upon the essential factors, and then the ability to put them in their right relations. On the whole, the best thing to do is to become friends with the foreman, if he is intelligent; if not, then give a cigar to the shift-boss.

Engineering Education

Recently we received a circular from Columbia University that outlined graphically the requirements of the various engineering courses based upon six full years of instruction after the high-school. The first three years of this work may be done at any of the better colleges by making an appropriate choice of subjects. The course in mining engineering at Leland Stanford University has also been lengthened to six years, but so far as we know these are the only institutions definitely requiring six years of university work, although there has been much discussion of the question and considerable agitation in favor of such a change. To some extent this is due to a growing conviction that engineering curricula should in-

clude more of the cultural and economic subjects rather than be confined almost exclusively to purely technical studies. This idea, we believe, is eminently sound. If, then, it be granted that philosophy, economics, English literature and composition, and perhaps some of the more practical subjects, including industrial organization, business law, and finance, should have a place in the college training of an engineer, we are faced with two alternatives, namely, either to cut down some of the technical courses that hitherto have occupied all of the time in the regualr four-year period, or to lengthen the period of the standard course by one or more additional years. Some who favor a lengthened course declare with great conviction that "four years of college work is not sufficient to make an engineer". They speak more truly than they know, for six or even a dozen years in college cannot and will not make an engineer. With respect to mechanical and electrical engineers, this view of the matter may not apply with equal force, but a mining engineer is not the product of any school; upon the completion of his college course he is simply equipped to make an engineer of himself in the minimum possible time. We are prepared to concede that at the end of six years of college work the young man is better qualified than he was at the end of only four years, but whether it would not be better for his career, as an engineer, to have devoted the last two years to the actual practice of his profession, is a moot point. Whenever this question is discussed a comparison is invariably made with the established curricula of six years for the training in medicine; there appears to be lurking in the background the feeling that the dignity of the engineering profession suffers somewhat from the implied reflection that it can be 'learned' in a shorter time than that of our medical friends. This, of course, is no argument in favor of a lengthened engineering curriculum; there are, on the contrary, distinct differences that make an excellent reason for a longer course in the school of medicine. The diseases and the symptoms, and perhaps, to a less extent, the cures, with which the physician comes in professional contact are unchanging. Much of his time is spent in clinics where the identical processes and operations that necessarily will form part of his future work are being performed; and moreover, he is, early in his career, called upon personally to assume the responsibility for human life. Fortunately, it is practicable to train the doctor in the college and its affiliated hospital. The work of an engineer, the mining and metallurgical engineer in particular, is different. His problems are constantly changing; entirely new conditions are met and have to be overcome; no two tasks are alike. His schooling therefore is not to teach him by practice how to do certain definite things, but to equip him to use ingenuity, resource, and judgment in applying science and art to the solution of new problems under varying sets of conditions for the purpose of achieving definite economic results. What then should a college course in mining engineering include? We suggest a sound broad foundation of mathematics, physics, chemistry, geology, mechanics, economics, and English, with a supplementary teaching that will show the relation of these subjects to mining and metallurgical problems. A valuable course would be one in which were given hypothetical problems involving ore deposits of specified character and composition that are to be mined, milled, and smelted. The solution might consist, not in a detailed practice to be followed, but in a general outline of the processes to be used, with references to the books in which data on each process are to be found. We submit that a man who has never been in a mine can study mining methods from a book for a year and learn less than he could from the same book in a week after he has spent six months working as a suveryor or sampler underground. The young mining engineer almost invariably is so situated that he has an excellent opportunity for study, and if he does not take advantage of it he is not the kind that will develop into a successful engineer. A book on copper-smelting or one on mine-sampling becomes tenfold as intelligible after a man has run furnaces for a few months or assisted an experienced engineer in examining a mine. The proposal is not to discard such studies from the curriculum; but the question arises, is there wisdom in trying to absorb a great mass of detail in a dozen different arts, many of which are undergoing constant change, and few of which will concern in detail the work of any particular graduate. The ambition of the student in mining engineering usually is to become a manager or executive, or to specialize in some one particular branch with a view to practising as a consultant. However, the average youth does not have a definite idea as to just the work for which his tastes and abilities will best fit him; in fact, until he has been engaged for a time in actually doing things, he is in no position to make a decision as to what to choose as his future work. If he is a handler of men, and his judgment is particularly sound, he will doubtless become an executive; college training in economic and cultural subjects will be of particular value to him; in the future, experience will be his best teacher. If, on the other hand, it develops through chance or otherwise—and we cannot honestly deny fate a considerable measure of influence in these matters—that the young engineer becomes a specialist in a given kind of work, the detailed information regarding a dozen other subjects that he may have accumulated will be of slight value to him. It is quite possible that he may be able to take a year of post-graduate work, in which case his efforts will be directed intelligently toward a definite end. We can appreciate the reasoning of those who think that in either case a four-years college course supplemented by two years of experience would have accomplished more toward ultimate success than six years spent at school. In the end the purpose of an engineering education is to develop clear thinking, good judgment, and the ability to apply scientific principles to the manifold forms of industry. Whether this can be done most effectively by giving a four or a six-year course in our engineering schools, and in either case, what kind of curriculum should obtain, are questions permitting sincere difference of opinion. We welcome discussion on any phase of the subject.



Two Suggestions on a National Problem

The Editor:

Sir—It seems to me that it is no use for this country, or any other, to fool itself into the belief that the oil and gasoline problems will be solved automatically; everything points to the reverse. In the United States, even though the production of petroleum increases each year, yet the known resources have been determined by the Geological Survey to be only a matter of a couple of generations. In the meantime, stocks have dwindled to a small quantity when compared with those of five years ago; while the uses of oil and its products are extending rapidly. In five years, the Pacific Coast States report a gain of 200% in the number of automobiles and trucks, and 400% in tractors. It is pretty safe to say that the increase in other States has also been large. I was in the East for six months in 1917-'18, and for ten months in 1919-'20, and noticed how many more motor-cars and trucks were in use. And this factor will continue to be an increasing strain on the oil industry. More engines of the Diesel type are being used, and, as D. M. Folsom remarked in an address before the American Mining Congress in San Francisco in January 1919, "the heart of the hydro-electric systems in California is the steam-plants in the cities, where power is generated by oil-fuel". It is not intended here to discuss hydro-electric power, simply to say that the new Water Power Bill should hasten development of the remaining forty millions of horse-power available, and eventually dispense with steam-plants.

Regarding the gasoline problem, the prime causes of the present position were ably discussed in the 'Press' of May 20, 1916, by J. H. G. Wolf. The intervening years have accentuated the trouble. Something has to be done, and I doubt whether the many lower grades of distillate or various forms of alcohol will be effective. As a substitute for gasoline or distillate for automobiles and trucks in urban areas, I have suggested city gas. According to Captain Brewer, who addressed the Engineering Societies in San Francisco a couple of years ago, during the War, some automobiles in England used city gas, which was stored in an unsightly bag atop of the machine. This gas was at low pressure, supplied by gas-works. My suggestion is to compress the gas to several hundred pounds, store it in a receiver on the machine, and pass it through a reducing-valve before use. Supply-stations could be provided, just as they are for gasoline. I communicated my idea to the Ford Motor Co., whose research department said it was not a practical solution of the problem; also to John A. Britton of the Pacific Gas & Electric Co., who has not replied yet. As if refuting the Ford reply, I find that in England the Government has been investigating the use of the Smith gas-producer on motor-trucks, as a substitute for petrol (gasoline) and other oil products. The Army authorities declare that the system is entirely satisfactory, and at the lowest known fuel cost, in this case coal at 55 shillings ($13.20 per ton normal exchange) producing gas equivalent to petrol at 3.4 pence (6.8 cents) per gallon.

Regarding the tremendous quantity of oil used under boilers to make steam, the number of stationary engines consuming gasoline, distillate, and low-gravity petroleum, and the tendency to increase the number of Diesel engines, I have advocated the use of producer-gas engines wherever possible. I have communicated my ideas to the Skandia Pacific Oil Engine Co., of Oakland, California, where I recently saw an 1100-hp. Diesel engine undergoing a test; the Union Gas Engine Co. of Oakland; and F. G. Cottrell, Director of the U. S. Bureau of Mines. The producer-gas type of power-plant is extensively used in Australia, England, and the Continent of Europe, and after studying its efficient use in the Western States, I wrote an article in July 1910 for the 'Mining Journal' of London.

Although the use of small producer-gas engines has not advanced in America, there are a good many large engines in the Eastern States being driven by blast-furnace gas; and I believe that the Ford Motor Co. at Detroit employs engines consuming city gas. Incidentally, I might mention another use of producer-gas: that being in the Humphrey gas-pump. By means of an explosion-chamber, and a large 'play-pipe', in which water can surge to and fro, enormous quantities of water are pumped, but through low-lift. Instances are those pumping 180,000,000 gal. daily for the water-supply of London, and also near Cairo, in Egypt, lifting 300,000,000 gal. daily for irrigation. In Australia this type of engine is used, up to 500 hp., for all kinds of work, competing with electric power. The fuel used is almost anything—coal, coke, charcoal, sawdust, sugar-mill refuse, sawmill refuse, and firewood up to 6-ft. lengths. I saw most of the seventy-odd engines then at work, producing 3400 hp., and heard little complaint regarding their behavior; and certainly none on the score of cost, then about one penny (two cents) per British horse-power for all charges. At Waihi, in New Zealand, a large producer plant, using coal, supplied gas to a number of 200-hp. engines, and the total cost was only 6 pence (12 cents)

per horse-power. I cannot see why the enormous quantities of waste from all industries in America, the low-grade fuels (even the coal of California at Tesla and Coal Canyon), the peat of North Dakota (Canada has already investigated its peat for this purpose), and many other combustibles should not be used in producers to make carbon monoxide for engines, and thus conserve the oil-supply and avert a crisis. For this reason I suggested to Mr. Cottrell that the Experiment Station at Pittsburgh make trials on such engines using the fuels mentioned. This is not only a national problem; it is international, and all oil-men are aware of it. I give my ideas for what they are worth.

MAX VON BERNEWITZ.

San Francisco, August 1.

An Interesting Experiment

The Editor:

Sir—There are several possible explanations for Mr. Gardner's experiment with gold foil and mercury, but just the same "it reminds me of away back when" we read the story of the scientists who discussed why it was that when one filled a bowl with water and then put in a stone the water overflowed, but when a fish was put in, instead of the stone, the water did not overflow, and after discussing the question for several days one of them thought to test the statement, so the bowl, the water, and the fish were brought together and the experiment tried, only to find that the water *did* overflow.

I am not contradicting the observations recorded by your correspondent, but only refer to them because the points involved are not definitely stated and we may be discussing something that 'ain't so'.

The first explanation is siphoning by capillarity. If the outside end of the gold foil is below the level of the mercury in the container, this will take place. If gold foil is dipped into mercury, the mercury will be drawn up on the gold foil to a point regulated by the attractive force between the mercury and the gold, the physical condition of the gold foil, and the static head of the mercury above the level of the bath. If the point to which the mercury will rise under the condition of the test is higher than the top of the siphon, the mercury will pass over and down the outside portion, and the amount of mercury on the side of the shorter leg of the siphon will be such that the attractive force of the mercury for the gold is just balanced by the weight of mercury sustained. Equilibrium will be reached when the same condition is reached at *C*, if the foil ends at *C*, but if the foil extends to a point below this, say *D*, the mercury will be drawn on to *D* and at this point the static head will be greater than the attractive force and it will drop off at a rate governed by the height of *B*, the temperature, condition of the foil, and the length of *CD*. Try this with a string and a glass of water, remembering that a certain length of *CD* must be allowed to compensate for the dryness of the atmosphere.

Mr. Gardner states that the levels *A* and *C* are the same, but as that is a condition almost impossible of attainment under the circumstances, he must be speaking generally. If the end of the foil is below *C* the above explanation is ample. If it is at or near *C* the explanation may be similar but due to inequalities of conditions. In the latter case equilibrium would be reached when *C* is supporting the maximum weight of mercury. If the apparatus is set up near a stamp-mill or dredge the vibrations might jar a small drop loose on the outer end yet be dampened by the bath on the inner portion. Similar conditions might be brought about by change of capillarity constant due to temperature variations.

Another explanation is that if the end of the foil is at

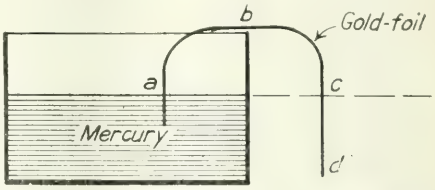


DIAGRAM SHOWING CONDITIONS OF THE EXPERIMENT

or near *C* and equilibrium reached, the mercury need not be saturated with gold. On standing, this would take place and both increase the amount supported and decrease the attractive force, with the result of the loss of a drop. The drop would be replaced by another unsaturated and this action taking place along the line result in a constant motion toward *C* until the gold is dissolved. This would explain why the action would not take place under water.

If the end of the foil is above the point *C*, I am inclined to believe it another case of the fish and the dish.

PHYSICIST.

San Francisco, July 30.

THE BUREAU OF MINES has recently published Technical Paper 229, 'Accident Prevention in the Mines of Butte', by Daniel Harrington, mining engineer for the Bureau. Mr. Harrington, in the course of an investigation of the health and safety conditions in the Butte district, conducted by the Bureau in co-operation with the U. S. Public Health Service, personally inspected practically every working-place underground in many of the mines of the district. In the investigation it was found that in nearly all the mines where much attention had been given to accident prevention, the results obtained were commensurate with the effort expended, not only in decrease of accidents of all kinds, but in the large saving to the companies in dollars and cents. The report describes in detail the safety organization and work of the several companies, gives statistics on the accident rates in Butte mines for the years 1915, 1916, and 1917, and presents conclusions and recommendations based on the results of the investigation. Copies may be obtained free from the Bureau at Washington.

The Bunker Hill Enterprise—XI

The Use of Electricity in the Operations of Mine, Mill, and Smelter—II

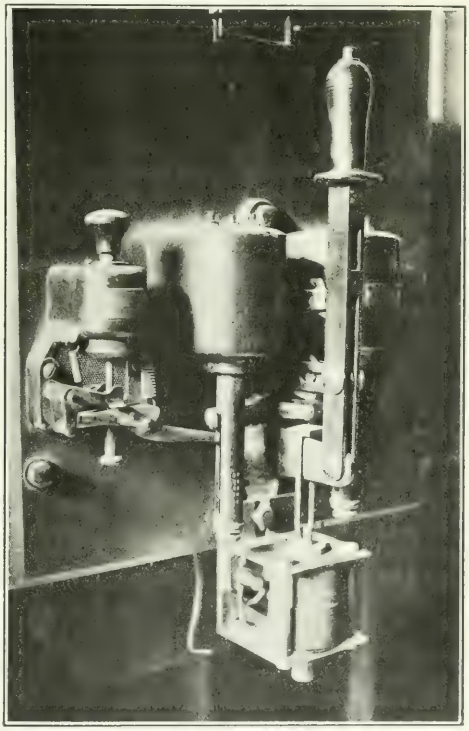
By T. A. RICKARD

The electrical energy used underground is delivered at 2300 volts, three-phase, at a point near the collar of the No. 1 shaft. The first cable for transmitting electricity underground was laid in 1906 in the Kellogg adit; it was covered with lead, without any jute or other armor, yet it has given uninterrupted service along the 10,000 feet of transmission. The second cable, parallel with the first, was laid in 1911; this has a double wrap of jute, in reverse lay, for protecting the leaden sheath. Both these cables are supported on a $\frac{3}{8}$-in. Siemens-Martin galvanized strand, using Boston clips with zinc straps that go around the cable. The clips are spaced about 18 in. apart. The strand, or 'messenger', is supported on L hangers that are bolted either to timbers or to expansion bolts ($1\frac{3}{4}$ in. diam.) flattened and drilled on the exposed end for receiving the hangers. In addition, the messenger is attached to eye-bolts with bridles every 500 ft., so as to take the strain each way and prevent slack in case the messenger itself should break.

The two cables have a combined capacity of 800 hp., sufficient to provide against any interruption of electricity to the pumps or hoist in the event of an accident in the adit. In 1918 a third cable was laid in the Reed adit, two miles south of the Kellogg portal. This last cable was furnished by the Standard Underground Cable Co. and is especially designed for the purpose. It is of the three-conductor type and 6000 ft. long, each conductor being insulated with 5/64-in. varnished cambric. A lead sheath, $\frac{1}{8}$ in. thick, serves as a protective cover against moisture and acid. This in turn is covered first with a layer of jute, then by No. 6 galvanized steel, and finally with jute. The insulation is designed for a constant pressure of 3000 volts.

This cable weighs 5 tons per 1000 ft., so it was ordered in lengths of 500 ft. and on special reels small enough to

W. J. LOCKE, MINE ELECTRICIAN



TRIPPING-DEVICE ON SWITCH, WHICH OPERATES FROM AUTOMATIC TELL-TALE, DEVISED BY M. J. BOTTINELLI

fit the mine-openings. In raises, or wherever the cable has to be hung at an angle, special joint-boxes are used. A sleeve, 7 in. diam. and 30 in. long, with brass flanges and plugs, is attached to the joint in the cable. This sleeve is filled with a soft compound, which flows into the cable, thereby compensating for the loss (due to the natural downward flow) of the same compound with which the cable is impregnated when it leaves the factory. Before pouring the compound into the upper joint-box, it is heated to 250°F. for about 15 minutes in order to expel any moisture; it is then allowed to cool before being poured into the sleeve. At the bottom of the inclined parts of the cable, an inverted joint-box is placed, for the purpose of preventing moisture from entering the cable and to seal it by pressure so that the compound cannot escape. Previous experience with other cables had shown that the compound would leak out of the ends of vertical cables, thereby impairing the insulation. The factory price of the special cable was $10,860 (in 1918, during the War) and the complete equipment, including the necessary raises, messenger wires, and other supplies, was $17,500.

All the pumps in the mine are operated by electricity and each is provided with a recording ammeter, marking the time when it was started and stopped, as well as the power consumed. By a scrutiny of the chart it is possible to detect the condition of the mechanical parts, as, for instance, a loose or broken valve. The water of the mine is relayed from the No. 14 and No. 15 levels to the No. 13, from which it is pumped to the top of the shaft at the No. 9 level, or Kellogg adit. The levels are 200 ft. apart. The combined discharge from the pumps in both shafts is 804,750 gal. per 24 hours, or 506 gal. per minute. The mine-pumps consume 4145 kw-hr. per day at a cost of $25.78, the cost per thousand gallons delivered at the collar of the shafts being 3.23 cents.

The first electrically operated pump was placed on the No. 11 level in September 1906. It was of the triplex horizontal type, with a capacity of 500 gal. per minute against a 400-ft. head, and was double-geared to a 75-hp. Westinghouse C. C. L. motor. The cost of it was only $1900. The second pump was placed on the No. 12 level in the summer of 1909. This was an Aldrich pump of the quintuplex vertical type; it had a capacity of 425 gal. per minute against an 800-ft. head and was geared to a General Electric 125-hp., 2200-volt, form M motor. The cost was $3120. The third pump was placed on No. 13 level of the No. 1 shaft in 1911. This also is of the quintuplex vertical type, made by the Birdsboro Steel Foundry & Machine Co., in Pennsylvania. It has a capacity of 500 gal. per minute against an 800-ft. head and is geared to a G. E. 150 hp., 2200-volt, form M motor. It cost $4300. On the same level, at the No. 2 shaft, there is another quintuplex vertical pump of the same design with a capacity of 550 gal. also against an 800-ft. head, and geared to a similar motor. This pump cost $4920.

The shaft-stations on the No. 13 level are about a thousand feet apart. A pump forces the water from one station to the other along the level. This is a horizontal three-stage centrifugal pump made by the Swaby Engineering Co. and has a capacity of 700 gal. against a 275-ft. head. It is direct-connected to an Allis-Chalmers 100-hp., 2200-volt, 1800 r.p.m. motor. The cost of this pump was $1545.

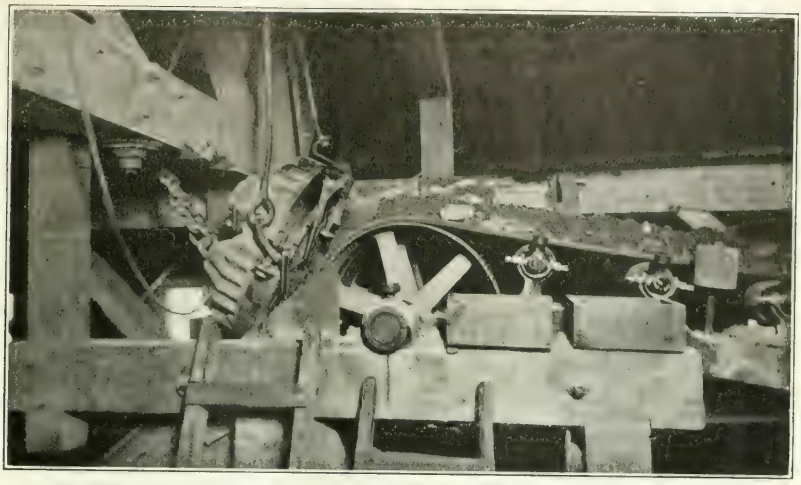
The water from the lower levels is assembled at the No. 13 level, where a large sump is established for the purpose of storage. This sump, of course, collects mud, which has to be removed periodically. To do this a 10-stage horizontal centrifugal turbine-pump is used. It was made by the Byron Jackson company of San Francisco and has a capacity of 250 gal. per minute under 800-ft. head. It is direct-connected to an Allis-Chalmers 150-hp. motor. This pump cost $3500. The cost of the various pumps as quoted here is f.o.b. factory and does not include the motors.

On the No. 15 level there is a seven-stage horizontal centrifugal turbine-pump made by the Byron Jackson company. It has a capacity of 270 gal. against a 410-ft. head and is direct-connected to a Westinghouse 50-hp. type CS motor. In addition, on this level, there is a four-stage pump of the same type made by the Cameron Steam Pump Works. This has a capacity of 400 gal. against 400 ft.; it is fitted with the Kingsbury thrust-bearings and direct-connected with a Westinghouse 75-hp. motor.

As an example of the hard usage to which electric apparatus is subjected underground, it may be stated that the third pump purchased by the company, and placed on the No. 13 level, was completely submerged under 200 ft. of water for three weeks, yet even after that experience the motor* was not disconnected from the pump nor the rotor removed before re-starting. The windings were dried by use of an electric current at low voltage furnished by the Curtis steam-turbine at the power-house operating at slow speed and by the aid of hot air-blasts from electric radiators assisted by electric fans. The fourth day after unwatering, the pump was started and has operated continuously since, showing no ill effects from the excessive water-pressure on the windings.

In a mill the use of electric power is advantageous, of course, on account of the small space required by electrical units and by reason of the extreme flexibility of such applications of power, the individual drives permitting the millman to shut-down any particular unit without interrupting the other units of a system. Constant speed is another obvious advantage afforded by electrical machines, which can be adjusted to a given speed and maintained at that speed, whereas if driven by gas or water the speed usually varies with the load. As engineers drifted from the direct use of the water-wheel and the steam-engine, they found that, with elab-

*The submergence of this motor was due to the fact that a fire at the top of No. 1 shaft cut off the pump-cable. The mine-fire started on October 7, 1912, and since re-starting the pump has been in continuous operation to this date.



ELECTRO-MAGNET OVER BELT-CONVEYOR

WELDING OF A CAST-STEEL KETTLE AT THE BUNKER HILL SMELTER BY AID OF THE ELECTRIC ARC

orate and expensive governors, they could get much better results from machines operating at uniform speed. Of such machines those operated electrically do the best work. Moreover, the use of electricity enables the millman to place the various parts of his equipment in the most convenient positions; for example, the magnet used to remove bits of steel in the ore before it goes to the crushers. This magnet had to be placed in a particular position in order to give maximum efficiency. See photograph. If a big piece of ore comes along it can push the magnet to one side, because the magnet is suspended by a sling, which allows it to resume its position once the obstruction has passed. Mill-men are familiar with the trouble given in starting an induction motor in a cold building, especially after a shut-down, with its thorough chilling of the grease and belting. Usually sufficient starting resistance is demanded from the manufacturer that supplies the motor, but in many cases this proves inadequate, so that at the moment of resumption either the motor or its starting equipment is taxed unduly. The Bunker Hill company has made it a practice to use only motors dependent upon external resistance, such as the M type of General Electric motors, where such duty is required. In a number of instances it has been considered advisable to substitute the water-rheostats to serve as a temporary means of accelerating slowly under extreme load as demanded under the conditions described. This method of starting may be deemed heterodox; it is used only in emergency to prevent shutdowns or delays, because the burning of the resistance units supplied by the manufacturer would prevent the starting of the motor and the excessive current taken through such resistance under the abnormal demand would cripple the motor. Mr. Handy, the superintendent of mills, was much impressed with this method of starting and frequently requested the electrical department to attach this type of water-rheostat to all motors operating under severe starting conditions, and where slow acceleration was desired, but Mr. Clark has been loth to do so on account of its rather crude form; instead he has requested the manufacturer to analyze the conditions with a view to providing the requisite apparatus. For instance, in any mill in which belting is used it is necessary often to put on a belt after lacing, by tying the belt to the rim of the pulley by means of a twisted rope and revolving the pulley very slowly so as to run the belt onto it. The water-rheostat enables this to be done comfortably, whereas the usual sudden starting, by means of the conventional device, makes it both dangerous and uncertain to do so.

The mills were illuminated electrically when first erected, but it is interesting to note the use of the Cooper Hewitt light (a mercury-vapor lamp) over the jigs and other machines where it is desirable to examine closely the feed and tailing, and be able to detect any given mineral in either. It has been found that by shifting these Cooper Hewitt lamps to different parts of the mill, without drawing the attention of the men, the efficiency of the supervision is increased. Recently the C 2 Mazda, or 'Daylight', lamp has been employed in similar places for the same reason.

At the smelter the fullest use is made of electricity; 108 induction motors, five electric locomotives, and three electric cranes are in service, the total motor-capacity being 3572 hp. Individual motor-circuits are provided with oil-switches that cut in ahead of the compensators so that repairs can be made without interruption to the main power-feeders. The electric system is sub-divided into a number of feeder-circuits, each terminating on a separate panel in the power-house. The main power-feeder comes to the smelter from the sub-station at the mine; it carries 13,000 volts, which is reduced at the smelter to 2300.

The most interesting application of electricity at the smelter is the Cottrell plant for precipitating fume. This plant has not worked as well as was expected, but the various difficulties have been fairly well overcome now, so that a 95% clearance is being obtained. As originally designed by the Western Precipitation Co., the structure was to have been made entirely of steel, but owing to the difficulty of getting structural steel during the War it became necessary to substitute brick wherever possible. This proved fortunate on account of the practice of adding water to the fume in order to expedite settling. The humidity has been increased by the use of spray in the chambers; this, in turn, has caused complications owing to the condensation of water in the 'treater' where the moist gases come into contact with the cold exterior. The resulting sulphuric acid has played havoc with the steel, so that the use of brick and cement has proved fortunate. All the steel parts that were exposed to the outside air have been destroyed in consequence of the corrosion caused by the moisture in the fume. The outlet-pipes and boxes have been replaced with wood.

The Cottrell plant consists of four sections, each of which has 64 pipes, of 12-in. diam., or a total of 256 pipes. In the centre of each pipe is hung a No. 10 jack-chain or a piece of No. 14 galvanized wire, at the end of which is suspended a 20-lb. weight, to keep the wire or chain taut. The wires and chains alike terminate on a common bus above each section, and this in turn connects, through suitable switches, with the rectifiers, where they are charged with 60,000 to 100,000 volts of direct current. It has been found advantageous to reverse the polarity of the current at frequent intervals during the day. The draft through the treater is downward; this aids precipitation, as the fume has to pass down the 256 pipes and close to the highly-charged electric conductors, the wires and chains, so that ionization ensues, and then precipitation.

The best results have been obtained under the following operating conditions: The nine roasters produce 125,000 cu. ft. of fume consisting of about 10% solid and 90% gas. This product enters a humidifying chamber, 33 ft. long, 16 ft. wide, and 34 ft. high, in which are placed four baffles, alternately hanging from the ceiling and standing upon the floor, but not extending to the full dimension of the chamber, so that the fume, traveling at

the rate of 14 ft. per second, is compelled to circulate around them. It enters at a temperature of 220°F. and is cooled in the chamber to 110°. On top of this chamber there are 150 nozzles, made by the Spray Engineering Co.; of these, only 70 are used at any one time. Water is supplied under a pressure of 225 lb., the 70 sprays using 36 gal. per minute. The average humidity of the fume, as it leaves the chamber, is 45%. It is further cooled about 10° while going through the treater, passing down the pipes at a speed of 8 ft. per second. An interesting fact has been noted here: after the water was added to the fume the lead content of the precipitated material increased 10%, as compared with the composition before humidification was adopted, whereas the silver content dropped 30%.

As for the electric current itself, this is generated at 220 volts A.C. single-phase and is stepped up to the high voltage (60,000 to 100,000) required for the treater in special General Electric transformers, after which it is rectified. For the four sections of the plant there were supplied three rectifier units, complete with the motor-generator sets and transformers. It was planned originally to use one generator set on two sections of the treater and keep one set as a spare. Experience proved however that one unit operating in all four sections did just as good work as two units could do, and at half the cost for current; in other words, the load on a generator unit is not increased by the addition of two sections. The treater is so designed that the dust is allowed to settle in a chamber at the bottom of the pipes. Twice each month the dust is collected and sintered in the treater.

The electricity is obtained from the Washington Power Co. at a cost of $36 per hp. per annum, this being the equivalent of $0.00625 per kw-hour. At the outset, in 1903, the rate was $88 per hp-year. There has been no interruption in the delivery of power, and no failure on the part of the Bunker Hill company's equipment, for more than two hours since the start 17 years ago. The present sub-station is of the outdoor type; it is equipped with three 1800 kva. transformers, stepping down from 60,000 to 13,800 volts. The transformers are oil-cooled and are equipped with disconnecting switches so that in case of trouble any transformer can be separated for inspection and repair.

In closing, I like to instance another beneficent use of electricity, even though it be on a small scale, namely, the Clague electrolytic method for the treatment of lead-poisoning. The accompanying photograph shows three smelter-hands undergoing treatment at the Wardner hospital. At times as many as 40 men are being treated for lead-poisoning at this hospital. The treatment consists in passing a weak electric current (110 volts, D.C., 75 milli-amperes) through the patient's body while his forearms and feet are immersed in tubs containing a normal (0.7%) salt solution. The treatment lasts one hour. As yet no research has been done to ascertain whether there is any actual withdrawal of lead from the body, but a marked improvement in the symptoms is noticeable after about five such treatments, this result being more rapid than when adopting strictly medical treatment. Experimental work elsewhere appears to disprove the idea that there is an actual deposition of lead on the electrodes in the bath-water. Lead-poisoning is likely to become chronic if repeated; the acute symptoms will disappear in a few days, but complete recovery is a slow business. This electrolytic treatment, like any other cure for lead-poisoning, must be continued for some time, but it appears to be more rapidly effective than any other. It is of special value as a prophylactic, and if used early it will prevent a severe attack.

ELECTROLYTIC TREATMENT FOR LEAD-POISONING

Signaling Mine-Hoists From Moving Cages

By C. A. ALLEN

The problem of signaling to the hoisting engineer from a moving cage has been considered by many mine operators for a number of years. There are several methods in use in different mining districts, but so far as the writer is aware they have been further developed in Utah than in any other State. The latest devices are of interest because they use a low-voltage circuit for the shaft-wires and also because the wiring can be so arranged that the hoist can be stopped from the cage, if so desired. The first installation in Utah was in the shaft of the Centennial-Eureka mine under the management of C. E. Allen. It was placed in operation in the summer of 1899, and has been in continuous and satisfactory operation for 21 years. The arrangement consists of two bare wires down the shaft carrying a current at 60 volts, with a device on the cage for making connection between the two wires. This device is simply a short piece of wire which is thoroughly insulated from the cage and is operated by a short lever. Whenever the cage-rider wishes to signal the engineer he pulls down the lever, forcing the short wire out against the two bare wires, thus making a circuit which rings the bell in the hoist-room. A similar device was placed in the Grand Central shaft at Mammoth, Utah, but was later abandoned. The cause of failure was reported to be that the shaft was very wet.

At a later date a system having the same general arrangement as that used in the Centennial-Eureka mine was placed in the shaft of the Eagle and Blue Bell mine at Eureka, but dry batteries were substituted, reducing the voltage to about 10 volts. This shaft is wet in places, but no trouble has been experienced. In order to give a better idea of the possibilities and application of the system, it should be stated that the hoist is a double-reel modern electric hoist with oil-operated clutches and brakes. The clutch and brake for each reel are actuated by different movements of the same control-lever. The hoist has the usual safety devices, such as limit-switches in the head-frame, position-switches for each reel, and ball-governor control. These devices are operated by what may be termed the control-wiring, which is in series with a no-voltage release on the switch-board. Should the circuit in the control wires be broken, the no-voltage release acts, which cuts off the power and automatically applies the brakes.

In the Eagle and Blue Bell shaft there are two No. 4 bare copper wires, one on each side of the shaft-guides. One of these wires is used for signaling from the levels, the second wire forming the return. The second wire is also used to make the circuit for ringing the bell from a moving cage. As regards signaling from the cage, it may be assumed that there is only one bare wire in the shaft, this wire extending into the hoist-room and through an ordinary Western Union relay-switch to the ground. On the cage is a battery of six dry cells enclosed in a piece of iron pipe for protection. One terminal of the battery is connected to the hoisting-cable and is thus grounded through the hoist. The other terminal is connected with an ordinary push-button switch and a piece of curved copper plate which, by means of a small lever, can be pushed out against the bare wire. The push-button is on the same lever. When the cage-rider pulls the lever, at the same time pressing the button, current flows from the dry cells through the bare wire, through the relay into the ground, thence through the hoist-cable back to the cells. The current flowing through the relay closes a separate electrical circuit, which rings the signal-bell. The current for the bell-circuit is supplied by 30 dry cells in the hoist-room, but connection could be made with a direct power or lighting circuit.

The important feature of this arrangement is that the dry cells, placed on the cage, give a low-voltage current, only 10 or 12 volts, eliminating all possibility of danger, such as would be present were higher voltage used. Also, if the contact-lever should be accidentally struck and contact made with the bare wire, the circuit would not be completed, because in order to close it the button must be pushed at the same time the lever is thrown. The use of the relay in the hoist-room is also important, because it permits the use of a low-voltage current in the shaft and a higher voltage to ring the bell. In order to stop the hoist from the cage by the same wiring system, it is only necessary to place in the control circuit of the hoist another relay so arranged that when the circuit is completed in the shaft, this relay will open the hoist-control circuit. As soon as this circuit is open the no-voltage release on the hoist switchboard will be operated, cutting off the power and automatically stopping the hoist.

O. N. Friendly, general superintendent of the Judge Mining & Smelting Co., is installing a modification of the Eagle and Blue Bell system for use in the Daly-West shaft at Park City. It is planned to do all the signaling from the cage and have no signal arrangement on the levels except the flash or buzzer system for calling the cage. A number '0' bare wire will be suspended in the shaft with insulators every four feet. Instead of a hand-lever to make contact against the wire, there will be a continuous contact with the wire as between an electric motor and trolley wire. Six dry cells will be placed on the cage as at the Eagle and Blue Bell shaft, and the relays and bell circuits on the surface will also be the same; push-buttons will be used to close the circuit.

Double-deck cages are in use, and to make it possible for a cage-tender to give signals from the cage, while standing on the station at either side of the shaft, four push-buttons will be used, two on each side of each deck. By this method there is no possibility of anyone signaling the hoisting engineer except from the cage. It not infrequently happens that careless or ignorant employees signal the engineer when they do not know where the cage is, causing the engineer to move the cage when it should not be moved.

Systematizing Large Mine Examinations

By MORTON WEBBER

Engineers usually experience lack of confidence in themselves when entrusted with their first large mine examination. Their experience has been gained from the examination of small properties and prospects. The obtaining of the data in such cases is relatively simple and the work is done personally by themselves. The time allowed for large examinations is seldom proportional to the time obtainable for small jobs. For the latter 30 to 60 days are frequently afforded. After the completion of the examination a cash payment is seldom required. In the examination of a large and supposedly valuable mine 60 or 90 days are usual periods for examination when a large initial payment is involved. To obtain the necessary data in the limited time afforded, the engineer therefore must employ a sampling crew, a surveyor, and draftsmen, and he will probably have to arrange to furnish a composite sample that is representative of the ore of the mine for a metallurgical test. This procedure is becoming increasingly common because frequently large deals involve new treatment plants. The valuing engineer should also furnish an opinion on what changes, if any, should be expected in the composition of the gangue and metallic minerals in depth.

Since the ore for the metallurgical test is procurable only from developed openings and since the contemplated plant must successfully treat ore beyond these exposures after the present ore-reserves are consumed, and for other reasons connected with a competent examination, it may be necessary to call in a geologist as a consultant. In that case it is particularly necessary for the engineer to have a thorough grasp of the principles of mine valuation to enable him to present questions to the geologist vital to the appraisal of the particular mine. Otherwise he will get a mass of geological data a great proportion of which is of small economic value; for few geologists are mine-valuers. If the engineer has therefore the experience, or natural aptitude, to determine what are the economic geological questions governing a particular case, although he may not have the geological training to answer them, and can focus the geological consultant on these features, he will save considerable time in separating essential from non-essential geological information.*

It is therefore axiomatic that the engineer whose experience has been confined to the examination of small mines and prospects will feel nonplussed and timid when attempting his first large examination. There will be the unfortunate feeling of not knowing how to go about it, or where to start. Experience gained from comfortably cutting about 150 samples and submitting a report in 30 to 60 days will not help much when tackling a large operating mine involving anything from 10 to 100 miles of workings, masses of past-production records, a roomfull of maps with which the engineer is unfamiliar but which must be grasped in short order, and the necessity of cutting from 10 to 50 tons of samples and producing a composite sample for a treatment test, the whole job to be finished in about 70 days, for in a 90-day option the investing clients must have time to 'turn round' after receiving the report.

I shall endeavor therefore to recite some of my methods in systematically arranging the examination of a large mine so that the report may be submitted within the allotted time. I will use a large silver mine for an example, as its examination was typical of the various points that confront the engineer when examining a large mine that has come on the market.

The vendors claimed three things: (1) The existence of an ore-reserve of 300,000 tons, which, based upon an operating cost of $7 per ton, represented an operating net profit of $1,000,000. (2) That owing to the past life of the mine being through years of lower silver prices, large areas of old workings can be mined at a profit. That for the same reason a large number of stope-fills can be drawn profitably and treated. (3) That the present mine bottom is hopeful, the grade of the lowest level being as good if not better than the levels above, and that the shoots are equally long. That other successful mines in the district are mining profitably 900 ft. below the present bottom of the mine under examination.

The intending vendee accepted the above statements as the basis for an option. He, however, believed that the mill was old-fashioned, that by modern plant a saving in operating costs and additional extraction could be made of $5 per ton or an additional profit of $1,500,000 through plant improvement alone. In addition to this, a saving of another $200,000 was hoped from improvement in mining methods. In the example under review stoping had been done by square sets and the preliminary examination, on which the above hopes were based, disclosed the possibility of employing shrinkage stoping with its obvious economies.

In the above example, and for that matter in all other examinations, the system I employ in procuring the data is similar. My methods may differ in degree but they do not alter. After I got over being frightened at the size

*This statement is not intended as uncomplimentary to the geologist. The training of the mine-valuer and the geologist is different. The valuer must think naturally along lines of finance, for mines are operated to make money. He must, however, understand geology sufficiently to appreciate the relation of geology to mine-valuation, for only thus can he ask intelligent questions of his less material brother, the consulting geologist. It is along these lines that teamwork between the engineer and geologist should be expected.

of the job I realized that the procuring of the data governing a large examination was as simple as obtaining the data for a smaller one. It is largely a question of doubling up the sampling crews and the number of trained assistants. The gulf the engineer has to cross is the step from doing most of the work himself to splitting the work up into departments under departmental heads.

A mistake the younger engineer is likely to make is to endeavor to get his sampling crew at work too soon. If he has brought a large crew to do the mechanical part of the sampling, the first impulse is to get them started. This is a mistake. The crew will get all the work they want before the examination is completed.

The first thing the engineer should do is to thoroughly familiarize himself with the mine he is reporting upon. For this reason it is preferable to detail an assistant to bring the crew a few days after his own arrival. If this is not feasible, as in the examination of mines abroad, where it is necessary to take the entire force *en bloc*, under no circumstances let the fact that your crew is hanging around for the first few days disturb you. The first thing is to thoroughly 'understand your mine'. This is best accomplished by investigating the workings and plant accompanied by the mine manager or some other person of technical training able to discuss the engineering features intelligently. If you want to make headway, do not treat him with suspicion. Treat him as you would like to be treated were you in his place. Because he is the engineer of the vendor it does not preclude him from being as honorable as you are. If you are just beginning to get the confidence of important capital interests (for this article is intended for the benefit of the junior engineer attempting his first big job), you may have some peculiar and unfortunate points of view. Some years ago I made a joint examination with another engineer who in his attitude toward the staff of the vendor showed himself to be a first-class snob and the friendly progress of our work was much impaired.

After a grasp of the physical situation is obtained, an investigation of the maps and records should be made. I was employed to report on a large operating mine in Canada that was under option to purchase. The vendee was a near-by mining company. I made arrangements to get my crew from the latter mine. They were to be forwarded on telegraphic instructions. By investigating the vendor's assay-maps I was able to prove on the basis of his own figures that the purchase price was unreasonable. In this manner the expense of a large sampling job was avoided.

After a thorough study of the property prior to sampling, the process previously referred to as getting to 'understand your mine', two important features should present themselves. The first is that the future life of the mine will depend on definite areas of ground, which, for simplicity, may be termed the prolongation of the deposit. This should not be confused with the ore-reserves, because their investigation is relatively simple. I refer to areas on which will depend the future life of the enterprise. Mines are seldom of interest to a purchaser for their ore-reserves alone. There is little profit nowadays in buying ore, because developed mines that are for sale are becoming increasingly scarce. The purchaser must hope to make the major profit during the future life of the property as the outcome of greater skill in intensive development, the profit to be gained by spreading overhead and standing charges over enlarged operations, and the economies and increased extraction obtainable from a modern plant. The future life will depend on the extension of profitable ore with depth, or the extension of the mine in length, or additional life expected from later discoveries of parallel veins that may rejuvenate the entire operation.

Accordingly it is my practice to start on this part of the sampling early; that is, to commence on areas vital to the consideration of the future life of the mine. In the particular examination under review the sampling was commenced on the lowest level. As stated, the adjoining mines were operating profitably at greater depth. It could be determined at an early stage whether or not this mine had an attractive future life. Assuming the sampling of the mine bottom showed up badly, a basal step would have been made in the examination. The engineer would know that the mine was of value only in respect to its established ore-reserves.†

If the engineer is familiar with the terms of the deal, as he should be, he can then judge whether or not, under the terms of the option, it is advisable to proceed with the remainder of the examination. Accepting the owner's figures of the ore-reserves as a basis for calculation, their value to the proposed buyer will become a banking question of risk and interest. A price has to be paid for the ore-reserves, as a present value, and the proceeds of their marketing will become interest-earning over a period depending on their rate of consumption. The 'yardstick' is Inwood's tables coupled with a knowledge of the metal market. If the sampling of the prolongation of the orebodies is disappointing the engineer should notify his client. This will permit him to demand a radical modification in the purchase price or to terminate further examination expense. There is usually little incentive in the purchase of ore-reserves unless accompanied by future possibilities and the benefits of enlarged operations.

The second phase that will present itself as the process of getting to 'understand your mine' is that large areas may or may not contain ore. I do not mean the ore-reserves or their immediate extension. The majority of mines offered for sale have been insufficiently sampled. There are usually extensive workings that are supposed to contain low-grade ore or where new shoots are supposed to be coming in. In a general way, these areas are part of the future possibilities and they excite cupidity. They are usually so extensive in area and their value so

†Attention is particularly called to this phase, for developed mines with important ore-reserves frequently come on the market because the more recent development of the property by the owner has disclosed the limited life of the mine. In such cases the owner hopes that the ore-reserves will 'carry the sale' and that the finite life of the enterprise will be unapparent to the buyer. 'Caveat emptor'.

problematical that to sample at a close interval similar to that used in the estimation of the ore-reserves would entail considerable expense. My practice is to give these areas a preliminary sampling at a wide interval of about 30 ft. In this way much can usually be eliminated from further consideration and valuable areas indicated by the preliminary sampling can thereafter be sampled at a close interval to determine their width and value.

I have now dealt with the two main phases that will present themselves prior to commencing sampling and will assume that the engineer has a general grasp of the areas on which the future life of the mine will depend after the exhaustion of the present ore-reserves, and that he has decided to give certain extensive areas of possible, but quite indeterminate, value a preliminary sampling.

The time has now come to get the sampling crews to work. There is a fundamental feature in my sampling in that I personally decide on the position and length of the sample-cuts. I do not delegate this part of the work to an assistant. The essence of a mine examination is the understanding of the particular mine as exhibited in the placing and width of the cuts. A few cuts placed by an engineer of experience are worth a raft of samples poorly placed. I therefore always 'paint my own job'. This is done by whitewashing and numbering the strips to be later sampled by the crew. In this way each sample is my own. The accumulation of experience or heritage gained from sampling other mines is thus transmitted to the particular examination. The mechanical part, cutting uniform channels, quartering down and assaying, can be delegated to others.

The whitewashing of the sample-cuts is done by having tags of duplicate numbers strung on a wire. There are two adjoining tags, say, 256, next to these are two tags, say, 351, and so on. Numbers are not allowed to be strung in regular order for reasons that will be hereafter stated. In this way the strips to be channeled can be rapidly painted and numbered. Adjoining each strip of whitewash, or calsomine, duplicate numbers are affixed with a nail. When the members of the sampling crew draw the sample they take down one of the tags and place it in the sack with the sample. The other tag is left on the nail. This affords permanent identification of the cut and prevents confusion of the samples, it also enables the surveyor to plat the cuts with their width on the map. In this way the sampling part of the examination is conducted in three successive operations. First, the engineer with paint-pot, nails, and tags, accompanied by an assistant who notes the width of the proposed cuts; second, the sampling crew acting under a boss who cuts a uniform channel for the entire length of the painted strip, and third, the surveyor who plats the position of the cuts and checks the width and uniformity of the channeling. This phase of the work is important. It is necessary to know that the men cut the entire width painted.

By the above method the examining engineer can keep a mine 'painted' far in advance of the sampling crew. An active man can paint enough in one day to keep three crews channeling for a week. In this way he can get his men all busy at underground sampling, commencing, as advocated, on the portions of the mine critical to the life extension of the enterprise. Thereafter he can devote his attention to the other phases of the examination.

In my practice the next step is inaugurating the department of mixing and quartering the samples to duplicate pulps. As this phase does not receive attention until the underground crews are at work, it is advisable to have an excess of sacks. This will allow the sampling crews to proceed without interruption during the training of the mixing-crew. After the mixing-department becomes efficient the excess of filled sacks can be worked off. The proportion of men cutting samples to those mixing will vary with every mine. The accessibility of the faces to be channeled, the amount of staging required to sample the backs of stopes, the sampling of raises and the hardness of the rock, make it impossible to suggest a standard proportion beyond that for every man in the mixing department, assuming it is intended to cut down to duplicate assay-pulps of 100 mesh, three samplers should be underground. This is merely a ratio on which to commence sampling. Adjustments should be made thereafter.

I will not describe the method of reducing samples to duplicate pulps, as this is standard practice. In respect to this part of the work, however, I may suggest that engineers frequently endeavor to reduce samples to pulp too quickly. I recommend a thorough mixing on a mat prior to cutting down. If this is done it will avoid a multitude of sins thereafter, for if a sample is once thoroughly mixed it can stand some careless treatment. If a sample is quartered with insufficient mixing and the opposite quarters are $5 and $7 per ton, and $6 and $8 per ton, respectively, it does not matter how much care is introduced thereafter, the error of 50 cents per ton at the start cannot be eradicated. For this reason I insist on all samples being mixed on a mat for not less than five minutes, depending on the ore. A clock is placed in the mixing-room so that the minimum mixing-time will be afforded.

After sampling is under way and likewise the reduction of samples, which should always be done on the surface, the next step is the map-work. In the case of large mines, where extensive maps are in existence, it is usually unnecessary to survey the entire mine. It is my practice to survey certain important portions of the workings and if the maps are found correct in these particulars to accept the remainder. On these maps I propound my own maps and make additional sections. It is generally necessary to compile different forms of maps to present the case clearly to my clients. Maps are the language of the engineer and this language should be clear and concise. Generally the maps of an operating property are sufficiently clear to the resident staff, as they are familiar with the mine. They are frequently insufficiently clear to a third party at a distance. I recently examined a mine where a plan showed that the workings curved like a bow. The sampling was shown on a longitudinal pro-

jection. One-half of the projection was foreshortened 60° and the remainder was foreshortened 25°. Such a sample map was misleading to even a trained engineer.

In the silver-mine examination the sampling of the stope-fills and the assembling of a composite sample for a metallurgical test was obtained at this stage of the examination, that is, after the sampling and drafting were safely underway. Had I desired to consult a geologist I would have engaged his services at about this time, as my work had progressed sufficiently to give me a thorough understanding of the mine and I would be able therefore to consult him on the particular points concerning which I wished to be advised.

In respect to the sampling of the fills, these were divided into two classes. Class 1, fills where there was good reason to believe their content could be treated with profit. Class 2, fills of more uncertainty. Small quantities were drawn from various stopes and placed in railroad cars and sent to a smelter for treatment. The object in dividing the fills into two classes and shipping separate portions was to prevent Class 2 from vitiating Class 1.

The method I employ of obtaining a bulk-sample for a treatment test depends on the size of the sample required. If a mill-test sample of 20 tons or upward is wanted, it is not procured until the mine is sampled. After the sampling-maps are completed it is feasible to shoot down portions of ore throughout the mine to furnish a composite sample representative of the average ore of the mine as disclosed by hand-sampling. This sample should be obtained on a foot-weight basis. That is, before making up the composite sample a foot-weight is determined upon, say for example, 50 lb. per sampled foot. If a mine has ten stopes, each stope will contribute its proportional foot-weight based upon sample-widths. If stope 'A' has 200 ft. of sampling it would supply two tons to the composite. If stope 'B' had 400 ft. of sampling it would supply four tons, and so on. In a ten-stope mine there would be ten components of the composite sample. The contribution from each stope is obtained by rows of 'pop-shots' uniformly spaced along the sample-cuts. In a large stope it is not feasible to pop-shot all the sample-cuts. In such a case it is my practice to shoot down a selected number of cuts that appear to represent the average material of the stope; and also to ascertain that the foot-dollar of the selected number is approximately similar to the foot-dollar of the total stope-sampling.

It is advisable to break down more than the foot-weight required from a stope rather than less. The excess above the stope foot-weight can be removed by cone-mixing. If too little is shot down the deficiency has to be obtained by removing more ore from the stope. This will introduce the personal equation which should be avoided after a method of sampling is determined upon. The assembling of the ten units or components of the composite sample so that the testing-plant will get the consignment as thoroughly mixed as possible is obtained by arranging the components in a circle and heap-mixing in the centre.

If a small test is required, 100 to 500 lb. for preliminary flotation tests, the sample is obtained from the rejects of the hand-sampling. The rejects should be stacked under original numbers. This is essential, for in the great majority of even profitable mines a large number of hand-samples will not come from ore-shoots and will therefore have no bearing on the case. By retaining all rejects until after the sampling has been platted and the average metal content of the mine determined it is possible to make up a composite sample representative of the profitable ore.

As stated heretofore, I avoid tagging the sample-cuts in consecutive order. This is to permit me to introduce the 'key series' of checking the sampling. This method was described in an article entitled 'The Detection of Salting', in the 'Mining and Scientific Press' of November 8, 1919. The method depends on removing a number of tags from various portions of the mine after the samples have been drawn and substituting new numbers. Instructions are then given to an assistant to have the original cuts re-channeled. The key of the old and new numbers is kept on my person. I do not expect the assays of each sample to agree closely each to each, but unless salting has been attempted or the cutting and assaying has been inefficient the averages should agree.

It is my practice to introduce two systems of key-series, one underground and the other by substituting the numbers of a series of pulps and having them re-assayed. The checking of a custom assayer is done by forwarding for assay two or more series of duplicate pulps masquerading under new numbers. It is obvious that if the sample-cuts were tagged consecutively the merit of the key-series, in that the examining engineer alone knows the key, would be lost.

The other phases of a large examination not discussed are the investigation of the title and the audit of the books. These duties may be placed on the shoulders of the examining engineer. Assuming that it is the engineer's duty to have this work done as part of the examination, as for example, in the case of an American engineer examining a mine in Colorado for a London company, the following procedure is suggested: The audit should be made when possible by a chartered accountant. Other accountants may be good and many of them are highly competent, but there is a security in the hallmark of the chartered accountant. Similarly a corporation attorney should be employed for the investigation of the title. In event of an engineer examining a mine in a community with which he is unfamiliar, and having the additional burden of passing on the earnings, financial state, and validity of the title, I recommend that he call upon a reputable bank in the neighborhood. He can thus get in touch with a responsible and competent attorney and accountant. Under no circumstances should he allow the vendor, his associates, or any person directly or indirectly connected with the sale to suggest whom to employ.

As the search of titles and the audit of the books cause considerable expense, it is suggested that this work

should be delayed until the engineer has a fairly good idea whether or not he will recommend the mine. He should not delay until rendering his report, for when the vendee decides whether or not he will proceed with the purchase the engineer's report, the audit, and the report on the title should be before him simultaneously. A better example of a tripod cannot be imagined. The audit may show the company in debt. The title examination may show that the corporation does not own the property. The engineer's report may show that the mine is bottomed. If one leg fails to stand up the other two will collapse. On the other hand, as suggested, the engineer should delay the examination of the title and the audit until he has reason to believe his report will be favorable. It is a waste of a client's money to pass on the title and audit the books of a mine that the engineer knows his client will not want.

Exploitation of Manganese Deposits

In the past, the steel industry of the United States has depended almost wholly on imports for its supplies of manganese. Many of the important domestic sources yield ores that in their natural condition contain less manganese than the foreign ores the steel industry has been accustomed to use. To make these domestic ores available, therefore, they must be concentrated or practice in the steel industry must be modified. Roughly, 25,000 tons of high-grade manganese ore is used annually for dry batteries, for chemical purposes, and in other minor ways, and approximately 750,000 tons is required for making steel. By present practice every ton of steel takes an average of about 15 lb. of metallic manganese, which generally is added to the steel in the form of an alloy. The standard alloys are 80% ferromanganese and 20% spiegeleisen.

On account of the irregularity of manganese deposits and the uncertainty of an adequate supply of ore, great care should be exercised in connection with the various operations, particularly with respect to prospecting and mining. Similarly, preparatory to the erection of a washing or concentrating plant, the factors that have to do with the success of the work must be carefully considered.

In general, as regards concentration methods, manganese ores may be divided into two groups, as follows: (1) Ores permitting mechanical separation of the manganese minerals and the gangue, and (2) ores in which the manganese minerals and the gangue are so intimately associated that separation requires some hydrometallurgical or pyrometallurgical process. Heretofore, attention has been confined almost wholly to mechanical separation, chiefly by gravity.

The principal considerations affecting the cleaning of ores are:

1. The character and grade of ore.
2. The recoverable percentage of mineral.
3. Relative value of crude to cleaned ore.
4. Basis upon which royalty is paid, whether crude ore or the cleaned product.

Aside from the clay and other materials more or less intimately mixed with manganese, considerable silica is associated with the ores. The silica may be 'free' or 'attached'. The free silica can be readily removed by washing, but the attached silica, being embedded in the ore or attached to it can be separated, if at all, with difficulty.

High-grade ores, particularly when occurring in large masses, and soft ore, as pyrolusite, should receive the minimum preparation consistent with proper cleaning. Low-grade ores usually require much more careful treatment than the high-grade ores, and the work and expense of concentration depend largely upon the impurities present. Free silica is not difficult to separate from the manganese. Soft ore, or 'wad', although of high grade, is difficult to clean without great loss from fine, particularly when much fine sand is mixed with the clay and ore.

The recoverable percentage of mineral in the wash-dirt depends largely upon the character of the mineral. Certain clays are readily broken and separated from the manganese, whereas others become pasty when washed, adhering tenaciously to the particles of mineral. As a rule, the larger the pieces of ore and the higher the grade the more readily is separation from the waste effected, owing probably to the smoother surfaces. Nodular ore of small and fairly uniform size is readily washed and jigged, but fragments from large masses and rough particles resulting from decay of limestone and possible incomplete solution of manganese are difficult to clean.

The relative value of crude ore as compared with that of cleaned ore may be the deciding factor in determining whether a concentrating plant should be erected. During the past year a considerable quantity of low-grade ore was shipped at a low price, simply because there was a market for it. The question is whether such ore could not have been raised in grade by concentration, so as to have brought a price that would have warranted the erection of a suitable plant. However, uncertainty as to the extent of the deposits and the length of time the prevailing schedule of prices would be maintained did not foster experiments of this sort.

The grade of ore upon which royalties are assessed has been the cause of considerable trouble in different districts, but in most of the districts during the past year royalties were paid on all ores coming within the schedule unless otherwise specified. In the future high-grade ores will alone be subject to royalty charges. Moreover, careful mining in well-proved deposits of high-grade ore will be necessary in the various manganese districts. The ores mined will, in turn, require either close hand-picking or concentration in well-designed plants in order to produce a high-grade ore, low in silica and phosphorus. With a dependable output of such ore, it should be possible to continue operation in the face of foreign competition wherever freight rates to consuming furnaces are reasonably favorable.—U. S. Bureau of Mines.

Flotation Mill-Runs v. Laboratory Tests

By FREDERICK G. MOSES

Introduction. At the present time a flotation plant is rarely built until the ore to be treated has been tested thoroughly in the laboratory and a flow-sheet carefully prepared. It is the object of the laboratory tests to determine all the small factors that may have a bearing on the operation of the larger plants. Within certain limits this can be done successfully and there are few finished mills that cannot be made to duplicate closely the results obtained in the laboratory. However, it must be borne in mind that in the mill it is sometimes necessary to do things that are not required in the laboratory in order to obtain the same results. It is usually a good plan to assume that success in the laboratory simply means that there are a certain set of conditions under which large-scale results can be obtained and that it will be necessary in the operating plant to duplicate these conditions in whatever way may be required, before comparable results are possible. This fact brings in a consideration that has often been overlooked. In the laboratory much of the work is done in order to determine the exact kind and quantities of flotation oils that will give the best results. It has been found, however, that the same oils that have given the best results in the laboratory may not give the same results when used in the mill. There are several reasons for this. They may be segregated under the heads of grinding, manipulation, water, and time of treatment.

Mill and Laboratory Grinding. There is no doubt but that the grinding that can be carried out in the laboratory and in the operating mill is different, and this difference is bound to have an affect on the results obtained. The different effects of grinding on flotation oils may be caused by any one of several factors, among the most important of which may be mentioned the difference due to grinding in batches, which is necessary in a laboratory, and continuous grinding, such as is done in the mill. This batch-grinding necessitates the use of the same water during the full grinding period, while in the large grinding machines the water continually changes to a varying extent. These two sets of conditions have decided effects on the action of the oils, particularly when the oils are added in the grinding machines.

It is difficult to name all the ways in which grinding may affect flotation oils, largely because we understand so little of the true action of the oils. One factor is the difference in temperature. Practically all flotation oils are more or less volatile and if the commercial machine operates at a higher or lower temperature than the laboratory machine, the results will differ. One experience of this kind that may be cited happened at Superior, Arizona. A large Hardinge mill was being operated at full capacity. It became necessary to reduce the tonnage in the mill, owing to lack of ore. It was found that when the smaller tonnage was being ground in the mill, the flotation results were quite different from those obtained when the larger tonnage was being ground. Various explanations were considered but the conclusion reached was that while operating on a small tonnage the pulp in the mill became excessively hot and volatilized some of the lighter constituents of the oil.

Manipulation. Another cause of variation in results may also be the different ways of handling the pulp in the laboratory and in the mill, or differences in manipulation, necessitated by the different conditions. When a mechanical machine is used in the laboratory and the oil is dropped directly into the pulp, we have a certain condition. The machine is operated until the oil is thoroughly distributed in the pulp, then speeded up and the froth taken off. Of course, this manipulation is different from that of the continuously operated machine and different results may be obtained even with the same reagents.

Difference in Water. Undoubtedly one of the greatest causes for varying results is the different water used. There is no question but what the physical and chemical characteristics of the water have decided effects on flotation results. Therefore, the same water should be used in the laboratory testing as will be used in the mill.

Effect of Time. Another factor that may cause a discrepancy is variation in the time of treatment. In the laboratory it is common to treat the ore as long as may be necessary to get a satisfactory extraction. This may require from 45 minutes to one hour and may necessitate adding small quantities of oil every few minutes. In the large mill the time of treatment can, of course, be varied, but the limits will be comparatively narrow. If the mill is so designed as to treat the ore for 45 minutes, an oil that would give satisfactory results in an hour in the laboratory could not be expected to give satisfactory results in the mill. If the ore can be treated only 45 minutes conveniently in the commercial plant, it is necessary to use an oil that will give the desired extraction within that period. It may be found that to do this requires an oil entirely different from that which has given satisfactory results in the laboratory.

Desirability of Mill-Test of Flotation Oils. These things have been mentioned to emphasize the necessity for continuing the testing of various flotation oils even if the mill has been built and is in successful operation. It has been found that many operators are prone to take it for granted that the oils they are using, or that they were advised to use by the testing laboratory, are the ones best suited for their purpose. This is seldom true; a small amount of experimental work in one unit of the mill will often give results that are much better than those already obtained and will more than pay for any extra trouble involved. Such experimental work will require extra labor and the purchase of additional oils for testing. The work may also result in the loss of the oils that may be proved less satisfactory but this loss is a comparatively small item, if the investigation proves that some other oil will give better metallurgical results.

The Yellow Pine Mine at Goodsprings, Nevada

Special Correspondence

The Goodsprings mining district is situated in Clark county, Nevada, about eight miles west of Jean, a station on the Salt Lake Route. The principal ores at Goodsprings are oxidized lead-zinc and copper-gold, some of the latter containing platinum-bearing minerals. The lead-zinc ore has a high silver content. The ore occurs near, and in places in contact with, large monzonite-porphyry intrusions. The contacts are conformable with limestone strata dipping 35°. The deposits are replacements, apparently confined to the limestone exclusively. The Yellow Pine is the largest producer in the district and since 1912 the company has paid $3,030,000 in dividends. The mine is 4½ miles north-west of the town of Goodsprings and the mill is in the town. The mine, mill, and town of Jean are connected by a narrow-gauge railroad built by the company in 1911.

GOODSPRINGS, NEVADA

THE YELLOW PINE MILL

The mine-shaft is 950 ft. deep on an incline of 35°. Hoisting is done with a two-ton skip at an average rate of 20 tons per hour from the 300, 500, 700, 800, and 900-ft. levels, where there are large skip-pockets. The shaft now in use was started in 1913 and was completed in 1915. Before 1913 work was done through a 300-ft. inclined shaft. Square-sets are used in the stopes, this method replacing a combination of the caving and shrinkage systems used prior to 1912. To assure a clean product, stoping is done with single-jacks. Forty men are employed on one shift and three machine-drills are used in development work. The output is 1600 tons per month. The surface equipment consists of a Fairbanks-Morse semi-Diesel engine operating a Fulton hoist, Ingersoll-Rand air-compressor, and a generator to furnish electric light and power for the mine, and power for a Blake crusher. A Chicago pneumatic direct-driven air-compressor is used as an auxiliary.

The mill was completely reconstructed and remodeled last year. The machinery, driven by a 100-hp. Fairbanks-Morse semi-Diesel engine, consists of rolls, jigs, and 6 Deister-Overstrom concentrating tables. The coarse crushing is done at the mine. The lead-silver concentrate is shipped and the zinc concentrate is calcined. The calciner, which was recently completed, treats the zinc produce by driving off the moisture and a large proportion of carbon dioxide, thus

reducing the weight and giving a material saving in freight charges. The United States Bureau of Mines is experimenting with a process to drive off by chloride volatilization fumes containing lead and silver. The fumes would be collected in a Cottrell precipitator. The perfection of this process would be of importance to the entire district.

The district comprises 400 square miles at the southern end of the Spring Mountain range. With the exception of the Yellow Pine, practically all mining is done near the surface, but some of the other companies have made remarkable production for the amount of work done.

MAP OF SOUTH-EASTERN NEVADA

The Boss mine is interesting as a considerable producer of copper and also as a producer of platinum, palladium, iridium, and gold. Other mines in the district that are or have been producers are the Alice, owned by the Yellow Pine Extension; Goodsprings Bill Nye, Sultan, Christmas Consolidated, Anchor, Bullion, Ingomar, Milford, Prairie Flower, Red Streak, Azurite, Annex, Copper Sides, Mobile, Whale, Oro Amigo, Potosi, Monte Cristo, Root Zinc, Copper Peak, Contact, Dawn, Singer, Tam O'Shanter, Green Monster, and the 20 patented claims of the Campbell estate.

UNDER the appropriation of $75,000 made for the investigation of the mineral resources of Alaska, the U. S. Geological Survey has dispatched seven field parties to the Territory. The work to be done is that of extending the surveys and investigations which were begun in 1898.

Osmiridium in Tasmania

The mining of the rare mineral osmiridium in Tasmania is attracting widespread attention, and it is said that the island promises to be the world's chief producer for some time to come.

For months past the Tasmanian Mines Department has been investigating the osmiridium fields of the west coast. The work includes a complete geological survey of the various fields in which osmiridium occurs, from Nineteen Mile creek in the north to Wilson river in the south, and the nature of the deposits and the distribution of this precious metal, which is now worth about $195 per ounce, has been carefully investigated. The publication of the complete bulletin is expected to throw much light on the subject. It was not until 1910 that the Department officially took notice of osmiridium among its mineral resources, and then efforts were made to ascertain values and outputs. These have since been carefully placed on record, thus enabling the State to enter the world's markets and attract attention to its new and promising source of mineral wealth. The Department ascertained in 1910 that 120 oz. had been produced in that year, and by its assistance the output in the following year was more than doubled. In 1912 the output rose to 778 oz., and in 1913 it was 1261 oz. This figure would have been far surpassed in 1914, it is stated, but for the War, and actually stood at 1018 oz. in spite of the check the industry received. Under the influence of the War for the next three years the output was 247, 222, and 332 oz., respectively. As osmiridium was a precious metal requisite for munitions of war, manufacturers, finding their usual sources of supply cut off, turned their attention to Tasmania. This resulted in keen buying, which sent the output up to 1606 oz. in 1918. With the close of the War the rush collapsed, and for the first quarter of 1919 only 209 oz. was produced, but more stable conditions set in and the production for the year reached the record total of 1669½ ounces.

The Tasmanian Mines Department recently published an interesting bulletin on osmiridium mining in Tasmania, prepared by Campbell Brown, who personally investigated the fields. According to this bulletin, the precious metal is found in various districts in the west of Tasmania, all of them more or less remote and somewhat distant from each other, yet bound together by a common invariable feature, namely, the occurrence in the neighborhood of great masses of serpentine rock. On the brow of Bald Head, in the Savage River district, facing Nineteen Mile creek, there is an osmiridium mine which is quite unique. Here a well-known miner, according to the official bulletin, has been quarrying solid serpentine rock for over six years and, by crushing it, obtaining high-grade metal. He is the first and only miner in the world, so it is officially noted, to find the precious metal actually occurring in the solid rock.

THE principal use of zinc oxide is in the manufacture of rubber products, chiefly automobile tires.

First-Aid and Mine-Rescue Contest

By F. J. BAILEY

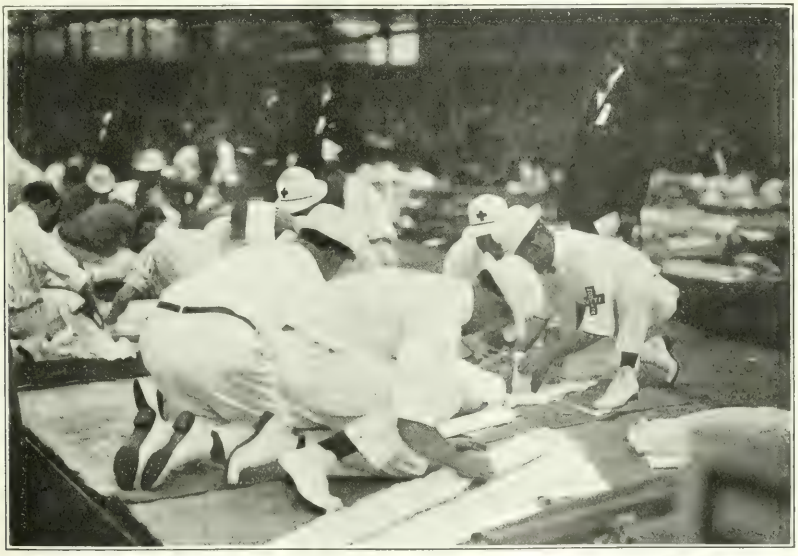
The event of the year, as far as the million miners of the United States are concerned, is the International First-Aid and Mine-Rescue Contest that will be held on September 9, 10, and 11 at Denver, Colorado, under the auspices of the Bureau of Mines.

The contest will be open to all first-aid and mine-rescue teams connected with the mining and metallurgical companies of the United States, Canada, and Mexico. Prizes of gold medals, cups, and banners will be awarded to the teams most proficient in the art of saving human life. A number of similar contests have been held in the past by the Bureau and each succeeding contest has aroused increasing enthusiasm among the mining fraternity.

A little more than ten years ago the Bureau of Mines, under the late Joseph A. Holmes, its first director, introduced into the mines a new method of life-saving, namely, the use of oxygen apparatus, which permits trained rescuers to enter a mine filled with poisonous gases that would kill in an instant. That allowed the formation of mine-rescue crews at the mines, and today there is not an important mining community that does not boast an expert crew of life-savers. With the trained rescue miner, wearing the oxygen apparatus, has come the trained first-aid man who takes the victim of a mine disaster and gives him the emergency aid that may save his life or prevent him from becoming permanently crippled.

Today there are more than 100,000 men in this country trained by the Bureau of Mines in modern first-aid or mine-rescue work, or both, all of them volunteers, ready to help their own or those in some other place, no matter

RESCUER EQUIPPED WITH OXYGEN APPARATUS



FIRST-AID TEAM FROM BUTTE IN COMPETITION AT PITTSBURGH

where. The Bureau maintains ten fully equipped mine-rescue cars with trained crews that visit as many mines throughout the country as they can, training men in modern life-saving, and now and then stopping their work to rush to a disaster and assist in a practical way in the saving of men from death. The Bureau also maintains ten stations and five trucks that perform similar duties. In this work altogether the Bureau employs 50 trained men.

The mining industry in this country employs more than a million men, and more than 3000 are killed each year while at work. This life-saving work has now been in existence ten years or more, and the records of fatalities show that in that time the lives of 5000 men have been saved. To state this in another way, had the fatalities been in the same proportion during the last ten years as in the preceding ten years 5000 more miners would have lost their lives.

There is such interest in these contests that teams have been busy all the summer in local and State contests preparing by competition for the big event. California, Kentucky, Alabama, Indiana, Oklahoma, Virginia, Iowa, and West Virginia have selected their best teams for the Denver meeting. The Lehigh Valley Safety Division of Pennsylvania recently held a 'No Accident' week and picked out the best teams in their localities to attend the contest in September.

Last year the contests of the Bureau were held at Pittsburgh, with 108 teams participating. This year the entries close on August 26, and must be filed with the Bureau at its Pittsburgh office. D. J. Parker, head of the rescue service, will have charge of the affair.

One of the spectacular events will be an actual demonstration of the utility of the aeroplane in rescue work in transporting engineers and oxygen apparatus to the scene of a disaster. While the rescue teams are showing their proficiency on the field where the contests are to be held, an alarm of a supposed mine disaster will be telegraphed or telephoned to the hangar of the nearest aeroplane of the U. S. Air Service. An aeroplane will be dispatched to pick up Bureau of Mines men and apparatus, bringing them to the field as quickly as possible.

Another feature of the meeting will be the formal presentation of gold medals to miners for deeds of bravery in saving life in the United States during the last three years. The awards will be made by Dr. Frederick G. Cottrell, Director of the Bureau of Mines, in behalf of the Joseph A. Holmes Safety Association, of which he is also president.

The Handling of Explosives

Explosives should be stored so that they will be in good condition for use, so that they will be available when desired, and in such quantities and in such locations as not to be a menace to life or property, says a recent bulletin by S. P. Howell, of the U. S. Bureau of Mines. Explosives will be in good condition if stored in dry well-ventilated magazines situated on well-drained ground. They should be purchased in such quantities that they may be used without an undue period of storage, and the older explosives of any desired brand and grade should be used first. The temperature of the storage place should not exceed 90°F. and the magazine should be protected by adequate means. Security against premature explosion or burning is obtained if the magazine be of incombustible material; if the ground around the magazine be cleared of combustible debris; if blasting-caps and electric detonators be not stored in or near the magazine; if the ventilators be screened to prevent introduction of sparks; if no boxes are opened in or near the magazine; if its contents be protected from bullets by its location or construction of bullet-resisting materials.

Magazines should be situated with respect to uninhabited buildings, public roads, and public railroads, in accordance with the American Table of Distances. This table represents the judgment of experts and provides a material decrease in the distances at which magazines may be located from buildings, railroads, and roads, if they be barricaded.

Good practice in the transportation and storage of explosives presupposes conforming to the following:

(1) Carry detonators and electric detonators, separated from explosives.

(2) Make-up primers at or near the working place.

(3) Keep electric detonators away from batteries, blasting machines, and other sources of electric current until immediately before blasting.

(4) Carry and store explosives at such times and in such places that, should premature explosion occur, it will injure the least number of persons.

(5) Keep explosives, fuse, detonators, and electric detonators away from open lights.

(6) Keep black blasting-powder away from electric currents, and especially do not transport explosives in a motor unless they are enclosed in a non-conducting receptacle.

In the preparation of primers and the charging of holes, the following precautions should be observed:

(1) Use a good quality of fuse and crimp it on the detonator with cap-crimpers that are in first-class working condition.

(2) Imbed the detonator or electric detonator in the cartridge of explosive and secure it firmly in place so that it may not become separated from the explosive. If fuse be used with the detonator, it should not be imbedded in the cartridge, for side-spitting may ignite the explosive and the full energy of the explosive be not obtained. If an electric detonator be used, wire should not be looped in such a way as to invite a short circuit.

(3) Put stemming in the drill-holes and tamp lightly if close to the explosive.

(4) Use wooden tamping-sticks.

(5) If firing is done electrically, connect the battery or blasting-machine after all other connections are made, and disconnect the battery immediately after firing or attempting to fire the shot.

(6) Do not use short fuse.

The Engineer and National Prosperity

By GEORGE OTIS SMITH

*No profession can claim exemption from citizenship. The constitutional privileges of citizenship are also constitutional obligations, for democracy distributes broadcast duties as well as rights. The engineer cannot dodge his responsibility as a citizen unless he is a conscienceless slacker. Moreover, even a reconnaissance survey of the subject is enough to show that the engineer has the making of a good citizen.

The best American citizen is and always has been he who lives not for today so much as for tomorrow. The pioneer and the volunteer soldier alike choose hardship and danger that there may be a larger measure of comfort and safety in the future. Regard for the future is not only a good definition of civilization but it is a practical kind of simple test to apply to our every-day motives: Are you and I seeking an easy today or a safe tomorrow?

Now, as I understand the requirements of effective citizenship, the engineer measures up to the specifications: he is forward-looking, he seeks to safeguard the future, and he is constructive by training and habit.

Need I say much to convince you that while to look backward is a large part of the lawyer-statesman's code, to look forward is the professional habit of the engineer? Where could be found better evidence of the vision of the engineer than this city of Washington? Our first President was successively a civil engineer, a military engineer, and a nation-builder; and his vision of the America-to-be was so far-reaching that his contribution to city-planning has proved no less adequate than beautiful, even though since he selected this site for the new nation's capital the population of the United States has increased more than twenty-five fold. Washington the engineer planned for national prosperity and planned well.

The engineer of today also thinks in terms of the future, and because he ever keeps the factor of safety in mind as he works I have chosen to call him an insurance agent of the first magnitude. National prosperity will not satisfy us unless it is backed up with guaranties of permanence, and so it is that I appeal to the engineers to help write this nation-wide endowment policy to run to the benefit of our children's children. My political conviction is that the future of our nation will be largely what you engineers make it, and national prosperity must be worked out in terms of the nation's industry. The public questions of the day are largely matters of production and distribution, and however humanistic or idealistic or altruistic you and I may wish to be, the future of America can be safeguarded only as the plans are drawn up by citizens like you, who trust to the eternal laws of matter and energy rather than to the broken reed of political expediency. This industrial nation needs citizens who will patiently lay solid foundations of fact and erect upon them structures of just action in which there is a factor of safety large enough to safeguard the nation's future prosperity.

The third link that connects the engineer and national prosperity is his constructive habit. It is not enough to know the truth; we have to translate it into action, and herein lies the distinction I draw between science and engineering: what science has discovered engineering must apply. Take this thought over into politics, and the peculiar usefulness of the engineer-citizen becomes almost self-evident. He has no use for the abstract except as the formula or the equation may affect his working plan. The engineering habit of mind is to trust implicitly the constants determined by science and tested by experience, but such faith is only the point of departure—works, not faith, is the engineer's creed, and it is his task in life to construct.

Now it is just this constructive tendency that we need more of in American politics. In political procedure we use practical engineering simply as a source of figures of speech—the terms 'log-rolling', and 'wire-pulling', 'steam roller', and 'side-tracking' are suggestive of the world of work, but only suggestive. In keeping our political institutions in running order, the legislative habit is to putty up any cracks in the structure that indicate weakness, without making any inspection of the foundations. And I regret to record my observation that in our legislatures, whether State or Federal, we find too little confidence in experts, possibly because the best of our scientists and engineers are rarely if ever seen or heard by those who control matters of statecraft. The skilful faker has had a standing here in Washington that he could not get in business circles. However, there has been some improvement in the status of the specialist, though even now a well-displayed sensational news item about a new motor fuel is likely to seem to the legislator a more acceptable basis for a Government investigation than a well-considered and therefore conservative statement by a chemical engineer of world-wide repute. Nor is the perpetual-motion variety of optimist without a hopeful following. Now it is this condition, this need of light, that demands a larger interest in politics on the part of our engineers, not so much through their great national organizations as in the capacity of individual citizens.

Our political temper today puts too much stress on legislation and too little on execution; we do not even reach the stage of a working plan. A new law is offered as the cure-all, whatever the evil that appears, and in devising the new law often the chief feature sought is

*A speech made at the Engineers Conference at Washington on June 3.

novelty: at least the remedy proposed must look new. The engineer's methods are different, both in planning his new structures and in putting them to use; to meet new requirements he usually adopts well-tested plans; he naturally seeks the safety of experience. And his structure once erected, his machinery installed, or his process perfected, he provides for its operation in accordance with his plans. This reliance upon well-tested facts of experience, this attention to the many details which taken together provide the requisite factor of safety, this 'seeing the thing through', are all working habits that the engineer-trained citizen can well take over into his political life. As I read American history, I believe that the intensely practical yet altogether progressive leadership of George Washington in affairs of state was possible because he was thoroughly a man of affairs, an explorer and pioneer, a leader in experimental agriculture, an administrator of business, a promoter of inter-state waterways, and even a drainage engineer. The earliest precedent that we have here in America, then, is that an engineer makes the best type of President; but most of us can only aspire to be useful private citizens, and more useful if active in public affairs.

The constructive habit is sadly needed in these days of change. The critic is abroad in the land, and he attacks our institutions as the wrecker rather than as the builder. My own conception of political reconstruction is best illustrated by what we have all seen, the erection of a new railroad bridge. The bridge-engineer may well be taken as the type of worker we need in public life. You have seen how, with his plans prepared to the last rivet, he has replaced the small and inadequate and possibly weakened bridge with the larger and stronger and up-to-date structure, and he has done this without interruption to traffic. His plans provide for one essential that is lacking in too many Utopian schemes: the bridge workers build up faster than they tear down, and therefore there is always a bridge to use.

This nation of ours is a going concern; indeed, the rate of our progress is much more rapid than many of our statesmen realize. Changes must be made to meet the demands of the heavier traffic, new structures must be erected, new motive power must be provided, and the effective citizen of today is one who can see ahead of the present moment, who can plan to meet safely the demands of the future, and who has likewise the will to build the needed structures, without tearing down too rapidly the house of state in which we live. I believe the engineer is a citizen of just that type.

Imports of sodium salts in 1919 amounted to 522,000 tons, valued at $20,704,000, as compared with 2,111,000 tons, valued at $90,939,000, in 1918. This great decrease in 1919 was caused almost entirely by a decrease in the imports of sodium nitrate, which is the sodium salt imported in largest quantity, the imports of all other compounds having actually increased in 1919 over those in 1918. The imports of sodium cyanide, sodium ferrocyanide, and sodium sulphide were notably greater.

Gilsonite

Among the natural hydrocarbons are gilsonite, elaterite, wurzilite, glance pitch, manjak, grahamite, albertite, and ozokerite. With the exception of ozokerite and other mineral waxes, they all more or less resemble asphalt in that they are dark brown or black bituminous substances of organic origin, generally with a resinous lustre.

Gilsonite or uintaite is an asphaltite characterized by a black color, conchoidal fracture, bright to fairly bright lustre, red-brown streak, specific gravity 1.01 to 1.10, hardness 2, and a melting point of 250° to 350°F. It is found only in the United States in a belt in the Uinta basin, about 65 miles long extending from Rio Blanco county, Colorado, into Uinta county, Utah, most of the important veins being in Utah. The veins are more or less parallel, having a general strike of north-west to south-east. They vary in thickness from a few inches up to 18 ft. and some are over 8 miles long. Branch veins joining the main veins at very acute angles are common. The walls, either of limestone or shale, are nearly vertical and are often so impregnated with gilsonite for several feet that no sharp line of demarcation exists. Close to the walls the gilsonite has the characteristic columnar structure perpendicular to the walls which is common to all asphaltites. Near the outcrop gilsonite loses its brilliant lustre and becomes a dull black through weathering. The methods of mining gilsonite are crude, little machinery being used. Little or no timbering is necessary, as the walls are usually strong and stand well. The ore is hoisted from underground, sorted, and packed in bags.

Two grades are marketed, 'selects' or 'firsts', and 'seconds'. Selects are taken from the centre of the vein and have a bright lustrous conchoidal fracture. Seconds come from near the walls and have a semi-conchoidal and semi-lustrous fracture. In 1918, 31,918 tons, valued at $863,826, or an average of about $27 per ton f.o.b. cars, was shipped from this district. Since the freight from the mines to the railroad averaged about $10 the average price f.o.b. mines was about $17 per ton. There were five producers in Utah in 1918. Gilsonite is used principally for the manufacture of paints, varnishes, and japans, and it is regarded by some as the most valuable hydrocarbon for this purpose. Unlike grahamite, gilsonite and glance pitch will mix in all proportions with fatty-acid pitches. Such mixtures are utilized for a great variety of purposes. Gilsonite is also used to a large extent in the rubber industry. Pure rubber is sensitive to heat and cold, but a vulcanized mixture of gilsonite and rubber has different physical and chemical properties and will resist both oxidation and changes in temperature. In such instances gilsonite may not be regarded as an adulterant but as a valuable constituent. Gilsonite also is used to some extent in prepared roofings and flooring materials, in paving cements, and, when mixed with other hydrocarbons, in pressed and molded insulation, electrical insulating tape, etc. Recent market quotations for gilsonite are reported at $55 per ton, f.o.b. New York City. U. S. Bureau of Mines.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

NEW PLANTS ARE UNDER CONSIDERATION

GLOBE-MIAMI.—It is reported that the International Smelting Co. is planning the erection of a large acid-plant. The purpose of this plant is to manufacture sulphuric acid from the smelter fume. Estimates are made that considerably more than 100 tons of sulphur is poured into the atmosphere each day in the form of sulphur dioxide. The acid-manufacturing plant will really be a by-product plant, as it will utilize a considerable quantity of this sulphur which is at present lost. The sulphuric acid produced will be used in the proposed new leaching-plants which will be constructed by the Inspiration Consolidated Copper Co. The mixed ores will be the first to receive acid treatment. At present only sulphide ores are being mined and treated by flotation; there is a high recovery of the sulphides and a low recovery of the oxides. The next metallurgical step will be to give the mixed ores the double treatment, first by flotation and then by leaching with acid solutions. After this practice has been fully developed, the next step will be the leaching (without flotation) of ores which contain oxides only.

The surplus acid will be shipped to a powder factory near Benson, Arizona, where it will be utilized in the manufacture of dynamite in a new plant at that place. It is reported that C. E. Mills, formerly general manager for the Inspiration Con. Copper Co., is president of the powder-manufacturing corporation, which, it is understood, is an association of the copper producers of Arizona, who will in the future manufacture the dynamite used in their mines from the sulphuric-acid output of their smelters.

A copper refinery in connection with the International smelter works is being considered also. This will avoid sending the pig-copper produced by the International company to Eastern refineries and the plant will probably also treat copper produced by neighboring smelters. If the proposed plans materialize, the copper consumer in the South-West will be saved something like 6000 miles of freight charges on the finished product, which under present conditions must be shipped to the Eastern seaboard to be refined and then returned to the consumers.

It is reported that the Grand Reef mine, in the Aravaipa district, in Graham county, about 60 miles north of Wilcox, has been purchased by the Aravaipa Leasing Co., which is controlled by the American Lead & Zinc Company.

The last report of the general manager for the Magma Chief Copper Co. to the stockholders is more favorable than former reports. Erection of heavy equipment is announced; also the fact that the engineers have reported available ores amounting to 250,000 tons. Doubling of the reserve within the next 90 days is predicted. Construction of a 100-ton flotation-plant is to start soon, the report says. Pending its erection the company plans to send 50 tons of ore daily to the Hayden smelter. Shipments of ores to the smelter have returned as high as 28% copper and 10 oz. silver per ton. As the ore comes from the mine it will average 9% copper and 6 oz. silver, with some gold.

BISBEE-WARREN.—The flow of water recently developed by the Copper Queen Con. Copper Co. in its Calumet & Cochise shaft, primarily for use in the new mill, now in course of construction, is sufficiently large to permit of a portion of it being used for irrigation purposes by the residents of Warren. This water is remarkably pure and clear and, coming from a tank high on the hill above the shaft, a high pressure is developed, which permits the use of revolving sprays for irrigation.

PATAGONIA.—A large body of copper ore is reported in the Wild Horse mine, situated near the 3-R mine, about seven or eight miles from Patagonia. Gray brothers, owners of the Wild Horse, have been in the district approximately 15 years and are enthusiastic over their find. H. J. Gray, senior member, was for 17 years superintendent of mines in the Tombstone district.

COLORADO

SILVERTON DISTRICT IS BOOMING.

CRIPPLE CREEK.—Production during July, as reported from the various reduction plants, totaled 38,222 tons; average value, $12.10; gross bullion-value, $464,568. The Golden Cycle mill at Colorado Springs treated 17,500 tons of ore averaging $20; Independence mill of the Portland G. M. Co., at Victor, 20,022 tons of ore averaging $3.10. There was shipped direct to smelters 700 tons averaging $75 per ton. The Portland company paid a dividend of $45,000 and the Golden Cycle one of $30,000 during July.

Tests on Blue Flag ore at the plant of the Denver Engineering Works have proved satisfactory, and a flotation unit will be installed at the mill on Raven hill, to be running by the end of September. Equipment has been ordered. Development at the 1200 and 1400-ft. levels is reported to be encouraging both as to the quantity and grade of ore under development. The Blue Flag com-

pany owns property in the Patagonia mountains, Arizona, and following the recent development on the World's Fair group, immediately adjoining, the lease and option to purchase the Blue Flag group has been cancelled. The Arizona property is to be operated on company account. Important discoveries have been made on the north-west slope of Battle mountain by the Portland company, and by the Modoc Consolidated company on the south-east slope of Bull hill. The Portland discovery, made on the Wisconsin claims, at a depth of 1700 ft., is reported to be rich in gold. The Modoc find was made at 1300 ft. from the Last Dollar or No. 2 shaft. The orebody in places measures 40 ft. in width and is of good milling grade.

SILVERTON.—San Juan county is experiencing unprecedented activity; old mines are resuming and new companies, soundly financed, are starting. Production will be far in excess of last year and may reach a new high mark. The Sunnyside M. & M. Co. has in excess of 400 men on its mine and mill payroll, and a larger force would be employed at the Eureka property if miners were obtainable. The mill is running at close to capacity. The Gold King Extension company is operating three shifts at mine and mill and heavy shipments of concentrate are moving to the smelter at Leadville. High-grade mill-ore is being concentrated at the Iowa-Tiger mill in Arrastra gulch and bi-monthly shipments are made to the Southwestern Leasing Co., operating the property. The Astor, Copper Bell, Toltec, and Mable mines are in operation by the United States Mining Corporation and shipments, it is reported, will shortly be moving. The Gnome Mining Co., operating the Columbus at Animas Forks, is opening rich ore in the vein cut last fall; a milling plant is to be constructed.

Powerful mining machinery is being installed by the Silverton Mines Co. on its Bandora property in the South Mineral district, 8 miles south of Silverton. The Mazeppa mine in the same district will soon be shipping; a good grade of ore is now being developed. The Red Mountain Mines Co., operating the Yankee Girl and Genessee near the San Juan-Ouray boundary, is shipping to the Durango smelter and the Barstow is producing and shipping high-grade concentrate to the Durango plant.

TELLURIDE.—The Smuggler company has a large force employed clearing away debris from the Pandora fire in preparation for the new flotation plant. Mine and store buildings are nearing completion. Machinery for the plant is arriving. The Valley View Leasing Co. has its new mill at the Matterhorn in operation and with large reserves of milling-ore blocked out the plant will be operated at capacity following test runs.

ASPEN.—A gold-bearing vein has been opened by an irrigation ditch on the Clavel ranch, about eight miles from the city. Samples assayed gave results of 35 oz. gold from a 12-in. streak of ore. The owner will develop the prospect "when he has time", he says. Supplies have been sent up to the Turley tunnel on Montezuma mountain by Aspen parties who have financed the locator, Henry Turley, who located a tunnel-site following the discovery of a vein of rich silver ore last fall. A mill-site has also been located. The property has good prospects.

MICHIGAN

MOHAWK.—WOLVERINE.—MAYFLOWER.

CALUMET.—Mohawk's operations, considering labor conditions, are continuing at a good rate and openings are on a par with those of a year ago. Production, however, is only about 50% of normal, but this is the general ratio that is maintained by most of the Lake Superior mines. In No. 5 shaft, on the 21st level, drifting is well under way in both directions. In No. 6, which also is sinking, the 17th level soon will be cut and drifting will be started. No. 4 shaft still is producing 'rock' that yields considerable over 24 lb. per ton on the 24th and 25th levels.

Mohawk is using stope-scrapers to advantage and arrangements are being made to install more of them in at least two shafts. At the same time experiments are being made with a 'zinc-field' scraper for use in the levels, and the miners are confident that the device will be a success. So far as is known, the only mines in which such a scraper is being used are the zinc properties, from which it derives its name. It is built so that it can draw the rock up an inclined level and drop it into the cars. If it fulfils predictions, it may go a long way toward attaining a goal that the whole Michigan copper region is seeking and the time when 11-lb. rock can be mined profitably may not be so far distant, as predicted recently by James MacNaughton, general manager for the Calumet & Hecla. Mohawk and Calumet & Hecla, to a certain extent, are working together in experiments with stope-scrapers and there is a likelihood that this device will be universally adopted for the C. & H. properties. Quincy also utilizes scrapers in its flat stopes and this method is usually succesful.

Wolverine will not complete the repairs to its mill for another week or ten days. Production is not suffering, however, for a stamp-head in the Mohawk mill has been allotted to Wolverine. Meantime both No. 3 and 4 shafts are operating, but, like Mohawk, production is about 50% of the peak. As soon as North Kearsarge is able to take care of the flow of water that seeps from South Kearsarge through Wolverine ground, Wolverine will be able to resume operations from the 38th to the 44th or bottom level. It is the extensive flow of South Kearsarge water into Wolverine that necessitated the shortening of Wolverine's ropes and the temporary abandonment of operations below the 38th level. There is considerable ground yet to be worked in the six lowest levels, but the water makes it impossible to get below the 38th at present. Since Wolverine holed through to North Kearsarge the flow of water is so great that No. 1 shaft of the latter is used for bailing purposes and all hoisting is being done in No. 3 and 4. It is understood that Kearsarge has ordered three large electric pumps to take care of the water, and once this equipment is in operation a resump-

tion of ore-hoisting in No. 1 shaft can be looked for at once.

Kearsarge shows some slight improvement in tonnage since the curtailment at Allouez and Centennial and a further increase is looked for within another month for a large number of Allouez and Centennial employees have been transferred to Kearsarge. The increase in the force is estimated to be 60 men. Meantime, Allouez is gradually getting its stopes cleaned up, with rock shipments since the suspension averaging about 325 tons per day. No. 2 shaft now is undergoing repairs and as soon as the interior is re-lined with timber and otherwise overhauled, similar operations will be under way in No. 1. Ahmeek has absorbed the bulk of the Allouez and Centennial workers and an appreciable increase in the July production should be noted.

Calumet & Hecla's No. 16 shaft, Osceola amygdaloid, is hoisting on only one shift, employing about 50% of the normal force. The production of other Osceola-lode shafts has dropped proportionately, while shipments from the shafts on the conglomerate have not been as heavy as last winter or early in the spring. With the reclamation plant producing at the rate of close to 1,400,000 lb. of refined copper per month, decreases in rock-shipments are not felt seriously, and while the labor problem has been one of the most serious that the Michigan copper mines have had to solve for the past six years, the fuel shortage has presented even greater difficulties. Although shipments have been coming with greater frequency during the past week or ten days, receipts must be far greater if a winter's supply is to be put in storage before the navigation season closes. Far removed from the coalfields, the only economical way in which fuel can be shipped is by water, but other lake ports are crying just as loudly for help as the Michigan copper country. The State of Michigan, however, has taken a hand in the fuel situation by the appointment of a fuel commission, and this section may get an adequate share of coal as a result of this arrangement. C. H. Benedict, metallurgist for Calumet & Hecla, is the northern Michigan member of the commission.

In connection with Mayflower's operations, the question of 'commercial rock' occasionally is raised. This may be answered briefly by the statement that the commercial value of rock can be determined only by a mill-test. Mayflower has about 1000 ft. of openings and less than one-third of the total are on the Mayflower vein. In the north drift, not more than 50 ft. was driven through the lode while in the south, the lode was opened by the drift, and eastward in the cross-cut. To the west, the cross-cut penetrated some vein matter, then entered trap and a mixture, breasting in the foot-wall trap. Grades in this region cannot be determined by assaying bits of rock, for the formations are too irregular. Accordingly the mill-test in a new section comes when a sufficient number of tons, probably 300 to 500 tons, of vein rock have been accumulated. It is Mayflower's intention to stock a sufficient quantity of rock to warrant a mill-run after the developments proceed farther. In the absence of such a test, the best barometer is the miners' experienc as he sees the openings from day to day. The Mayflower lode contains fine copper, in granular form, and the miners who helped to sink the shaft are confident that where the formation is regular, the rock will be commercial.

THE IRON CAP MILL AT COPPERHILL, ARIZONA

NEVADA

DEVELOPMENT MILL AT GOLDFIELD IS TREATING 100 TONS PER DAY.

OREANA.—The Pershing County Mines Co. is buying machinery to be used in re-opening the Jersey mine, which is credited with a production in the '70s of $200,000 to a depth of 75 ft. The company has an option on the Montezuma, from which a good production also was

made in the '70s. The company was promoted by Glenn D. Cook of Salt Lake City, and the principal stockholders are Salt Lake City men. Cook shipped $75,000 worth of ore from dumps before organizing the company for deep work. A 100-ft. shaft on the Montezuma is to be sunk to 200 ft., where a cross-cut will be driven to the vein. In the early days a shaft sunk on the Montezuma passed out of the ore at a depth of 75 ft., but the ore, raking west, is reported to have been found in a drift that is now caved. The shoot was 100 ft. long and 5 to 15 ft. wide. The ore contained jamesonite, a sulph-antimonite of lead; bindheimite, an amorphous antimonate of lead formed by alteration of the jamesonite, cerussite, gypsum, and antimony. The Montezuma and Jersey mines are four miles from Oreana, which is on the Southern Pacific in Pershing county.

Carson.—J. F. Shaughnessy, of the Nevada Public Service Commission, declares the 25% increase in freight rates granted to the railroads operating in the mountain States "will seriously cripple, if not destroy, Nevada's mining industry". He thinks the new rates will result in decreased revenue for the railroads operating in Nevada, as he says it will result in the closing of many mines now shipping. In illustration of this, he points to the Virginia Louise mine at Pioche, now giving the Los Angeles & Salt Lake road $300,000 gross earnings annually. The Virgina Louise is operating on a profit of 50c. on each ton of ore shipped. Mr. Shaughnessy also said that the increased rates possibly will amount to more than the net earnings of the Nevada Consolidated at Ely. Mine operators of the State have feared the effect of the increase, as it will be felt not only by the companies shipping ore, but companies working prospects will be compelled to pay much more for everything used, from powder to food for the miners.

Arrowhead.—A 3-ft. width of ore assaying $500 per ton has been opened in the 150-ft. west drift on the 100-ft. level of the Arrowhead, according to A. H. Elftman, consulting engineer to the company. Drifting has been started on the 267-ft., or bottom, level. The Consolidated is drifting from a cross-cut to the vein at a depth of 215 ft. Drifts are being driven east and west in a body of quartz giving low assay returns. J. H. Goodman and S. H. Williams of Ely have bought the Signal claims, adjoining the Arrowhead on the south-west and it is reported that they will organize a company to develop the group. A 100-ft. shaft was sunk by former owners and this can be continued by the new company.

Rochester.—The mines here and the Nevada Packard are closed because of lack of power and they are not expected to re-open for more than a month. Electric power for the district is furnished by a company using water from the Lahontan reservoir at Fallon, which is practically exhausted.

Ely.—The Nevada Consolidated mined 791,151 tons of ore of an average value of $3.27½ from April 1 to July 1. The gross value of the ore was $2,591,348. Cost of management was $47,562; mining, $607,187; transportation, $256,393; reduction and sales, $1,438,237, making a total cost of $2,349,379. The net realization was $241,968. No ore was mined by the Coppermines company during the quarter. Royalties received from lessees amounted to $2231 net. The cost of management was $10,539 and mining, $78,018, leaving a net loss of $88,557.

Tolicha.—The W. J. Loring interests are negotiating for the purchase of the Southey group of claims, two miles from the Harney group. Southey has fixed the price at $50,000 and he is in Goldfield awaiting the arrival of those who are expected to close the sale. Other sales of claims are reported to be pending on the strength of recent developments in drifts from the Harney tunnel.

Goldfield.—The Silver Pick has secured a lease on practically all of the Red Top mine of the Development company, including the part in which a large tonnage was broken by the Development in two blasts about a year ago. The lease was granted because the Silver Pick can mine the ore more economically than the Development and return a better profit to the Development than if that company did the work, according to Mat Murphy, superintendent for the Silver Pick. The Development has no air-compressor available for this work and air from the Silver Pick can be used with little expense. The workings are in good condition and the Silver Pick expects to make a good production of ore assaying $10 to $20 from them, in addition to opening higher-grade ore in the foot-wall of the vein. The Pick is shipping regularly to the Development mill, which is treating daily 100 tons of ore from several sources.

The Deep Mines Co. has announced that the proposed 3000-ft. shaft will be sunk on the southern end of the Combiantion claim, east of the Atlanta. There is a two-compartment shaft at this point that is thought to be 400 to 600 ft. deep. This will be enlarged to four compartments and sinking will be started from it, with two shifts of miners employed. Nine men are building a road to the shaft and excavating for the foundation for a 75-hp. hoist, which will be used until sinking is started. The Merger equipment, capable of hoisting from 4000 ft., will then be used. H. G. McMahon, secretary for the company, says the exchange of stock "has been successful to a marked degree". The Kewanas has secured a lease from the Deep Mines. A small compressor will be used in driving a cross-cut from the 825-ft. level of the Merger shaft to prospect a vein that has produced ore from the surface to 300 ft., but which has not been prospected below that depth except by a cross-cut at 600 ft., which shows the vein to be 15 ft. wide. Assays as high as $6 were secured in the cross-cut. Regular shipments of ore assaying $12 to $24 are being made to the Development mill from the Cracker Jack lease on the Florence.

UTAH

UTAH METAL PRODUCTION.

Salt Lake City.—Some interesting figures on the mineral output of the State have been compiled by Henry M. Adkinson, mining engineer of Salt Lake City, from reports of the U. S. Geological Survey. Since the discovery of metal in Utah in 1863 to the close of 1919, the total

value of the gold output of Utah has been $98,138,503; of silver, $298,109,421; of copper, $426,034,339; of lead, $207,508,430; and of zinc, $17,751,225, making a grand total of $1,047,641,934. Up to the close of 1917, Bingham had an output of $419,699,686; Park City, $169,814,024; Tintic district, $180,401,804, and forty-six other districts, $146,239,823, making a grand total of $916,155,337. The total value of the 1918 mineral output of the State was $86,047,597 and of the 1919 output, $45,439,000, but figures showing the distribution of these totals among the various mining camps have not yet been prepared.

EUREKA.—A mechanical shoveling machine, of a simple and practical type, has been developed at the Tintic Standard mine. So far as is known, this is the first time the device has been used underground. On the 1100-ft. level of the mine, in the main north-south mineral channel, a large stope of dry silicious silver ore, which averaged over 30 oz. in silver per ton, has been opened. A road-scraper, handled by two men, is being used to load the broken ore into mine-cars. A small air-hoist has been set up, from which is run a steel cable to the scraper. The scraper is loaded and hauled up on inclined slide to the cars by this cable. About two scraperloads fill a mine-car, and much hard labor is saved. On this level the temperature is so high that it is almost impossible for shovelers to work with comfort. This new stope of silicious ore on the 1100-ft. level is about 100 ft. west of No. 2 shaft. So far as present developments indicate, the ore is from 40 to 50 ft. wide. The ore-zone has been proved to a depth of 1400 ft.; on the 1450-ft. level, a raise has been put up for a distance of 50 ft. in a stope of high-grade galena, which contains considerable silver.

Shipments for the week ended July 31 totaled 146 cars, of which the Chief Consolidated shipped 46; Tintic Standard, 27; Eagle & Blue Bell, 15; Dragon, 10; Iron Blossom, 8; Mammoth, 7; Grand Central, 7; Iron King, 6; Gemini, 4; Victoria, 3; Swansea, 3; Bullion Beck, 3; Centennial Eureka, 3; Zuma, 1; Victor, 1; Alaska, 1; and Gold Chain, 1.

It is announced that the Knight interests will temporarily suspend work at the Tintic drain-tunnel. It is understood that this also means that operations will be suspended in the Ruby Hill shaft, which has been sunk to a depth of 700 ft. About 25 men are being employed in the tunnel and almost as many at the shaft. The Knight people state that they have no intention of abandoning the drain-tunnel, but the large stockholders do not feel like meeting the heavy assessments at the present time. It is hoped that work will be resumed by fall.

It is reported that one of the Salt Lake valley smelters is trying to make a deal for the treatment of the big mill-dump of the Mammoth Mining Co. Figures on file in the office of the company indicated that the dump contains 250,000 tons and that its metal content averages close to $7 per ton on the basis of present metal prices. The Mammoth is one of the pioneer properties in this camp, and at various times in the past, offers have been made the company for the treatment of the tailing, none of which has been accepted.

PARK CITY.—The Judge Mining & Smelting Co. has prepared plans for a new office building to supplant the one now occupied in Empire Canyon. In addition to office-rooms, there will be a large drafting-room, as well as change-rooms, equipped with the latest drying paraphernalia, shower-baths, etc., for the employees. The Park Utah company has its first lot of ore at the Daly-West loading-station awaiting transportation to the railway. Conditions at the property are reported as excellent. Shipments for the week ended July 31 totaled 1901 tons, as compared with 2349 tons for the preceding period. The Silver King Coalition shipped 693 tons; the Ontario 550 tons; the Judge M. & S., 419 tons; the Daly-West, 119 tons; Daly, 60 tons; and the Naildriver, 60 tons.

ALTA.—Unwatering of the workings of the Old Columbus Consolidated mine was accomplished recently by the connection made between the Wasatch Mines tunnel and the 400-ft. level. The Wasatch Mines tunnel was started not only for the purpose of tapping the Columbus workings at depth, but to furnish transportation and drainage for the other Alta mines. Some twenty years ago, the Columbus Consolidated was a producer of high-grade ore. When the 400-ft. level was reached, trouble with water prevented economical operation. All operations were suspended, and later the Wasatch Mines Co. acquired the property and started the main working-tunnel. When the face of the tunnel had been advanced 5538 ft. from the portal, a cross-cut was driven along the fissure 250 ft. back of the face until the Cardiff overthrust contact, in which the richest mineralization was found in the Columbus workings, was intersected. Drifting was started along this fissure. At a distance of approximately 500 ft. from the point at which the tunnel left the main adit, the contact was cut. On this contact a two-compartment, 9 by 5-ft. raise, has been made in

SIMON-CONTACT SHAFT NEAR MINA, NEVADA

good milling ore. One foot of the ore is excellent shipping product, averaging $70 per ton in gold, silver, lead, and copper. The management made the connection with the 400-ft. level 140 ft. above the cross-cut. When the connection was made, a flow of water, four feet deep in the adit, flowed for 24 hours. The No. 3 shaft had 70 ft. of water and several miles of drifts, tunnel, etc., were full of water.

WISCONSIN

DISTRICT IS STILL SHORT OF MINERS.

Higher average prices paid for zinc and lead ore maintained production through July in spite of critical labor conditions. Several large producers suspended output on account of an acute shortage of shovelers, and two others shut-down because their ore deposits were exhausted. The better tone in the slab-zinc market is the natural result of curtailed output of zinc ore in other districts, especially in the Tri-State region. A reserve in in the Wisconsin field, conservatively estimated at 10,000 tons of green concentrate, is held principally by magnetic ore-separating plants and a few of the large zinc-operators. This reserve remained practically untouched through the month of July and should price offerings for high-grade blende continue at the base reported for this month it is probable that this reserve will be disposed of quickly. While there was a feeling of gloom spread over the field prior to July 1, this gave way to a more cheerful attitude as prices began to climb, and the close of the month found many with the disposition to renew exploration work, undertake new construction, and extend the scope of operations generally. The fly in the ointment is the scarcity of shovelers. Many competent miners have been attracted to the harvest fields, and not until one of the best crops known to the district is gathered will there be any relief from this quarter. Negroes have been obtained in fair numbers and it is said they develop into good miners. Wages are the highest ever known to the field and husky shovelers willing to work can on contract earn as high as $12 per shift.

High-grade refinery blende opened up the first week of the month on a base of $48 per ton. Production of raw ore at mills ran close to 3300 tons for the week, and, strangely, as fast as offerings advanced production decreased. The scarcity of men was responsible. On July 10 offerings were advanced to $49.25 per ton, base, and penalties were not considered. On July 24 the price advanced to $53, with the latitude on zinc assays widened. The closing week saw high-grade zinc ore selling on a range of $51 to $53, with choice grades in good demand. The recovery of low-grade zinc ore fell to 2000 tons per week during the last three weeks of the month and it is safe to say that under present conditions not much larger yield may be anticipated. Only the larger and better deposits are being mined where working forces are not normal.

Lead ore, which ruled high this year at $110 per ton, suffered repeated cuts until the price was brought down at the beginning of the month to $90 per ton, 80% metal content. About mid-month an advance was made, bringing the price back to $92.50 per ton. Without much prior notice another advance came quickly to $100. A growing scarcity of ore is mainly responsible for the advance in the price of supplies available, but a shortage is evident as the lowered production of zinc mill-feed is mainly responsible for the decreased output of lead ore. No published figures were given out in the closing days of the month, but lead-ore buyers were scouring the district for stocks and offerings had advanced to $104 for choice lead concentrate. It was predicted freely that the ground lost would be recovered shortly and that lead ore would again command the high price of earlier in the year, namely, $110 per ton. The reserve in the field at the close of the month exceeded 1000 tons of lead concentrate. The lead deposits for which the Wisconsin field was famous in early days seem to have been well searched out by the pioneer miners.

Iron pyrite is in poor demand, the only shipper being the Zinc Concentrating Co., of New York, with deliveries to the General Chemical Co. The operation of a new sulphuric-acid plant for the Vinegar Hill interests, at Cuba City, was thought would benefit the market, but this conclusion was wrong. The fumes necessary to manufacture acid are taken up in the process of zinc-ore separation and raw pyrite is not necessary. Shipments of carbonate-zinc ore were low and confined to clean-up shipments, as the mines have all suspended operations in the northern districts of the field, from which this grade of ore has been principally obtained.

Deliveries by districts, for July, to magnetic separating plants in the field were made as follows:

District	Zinc ore, lb	Lead ore, lb
Benton	9,830,000	304,000
Livingston	6,068,000	60,000
Cuba City	2,808,000	102,000
Galena	1,802,000	236,000
Platteville	1,286,100	.
Shullsburg	1,164,000	70,000
Hazel Green	552,000	.
Day Siding	538,000	.
Highlands	240,000	.
Linden	500,000	.
Total	24,788,100	772,000

The recovery of milled concentrate for the month at mines amounted to 12,394 tons, all ore being disposed of on current output. Net deliveries of high-grade blende shipped to smelters amounted to 7205 tons, distributed as follows:

Company	Lb
Mineral Point Zinc Co.	7,202,000
National Ore Separators	3,470,000
Wisconsin Zinc Co.	2,406,000
Block-House Mining Co.	804,000
Zinc Concentrating Co.	528,000
Total	14,410,000

The closing down of the Champion mine, in the Benton district, on account of a shortage of shovelers removed the best individual producer in the field. The mine has averaged 300 to 400 tons of zinc concentrate weekly. The Blewett mine, in the Galena district, also shut-down; the low price for 40% zinc concentrate was stated as the cause for the suspension. The Bull Moose mine resumed shipments, for the time being at least, in order to relieve congestion at ore-bins.

BRITISH COLUMBIA

REPORT OF SILVERSMITH MINES, LTD.

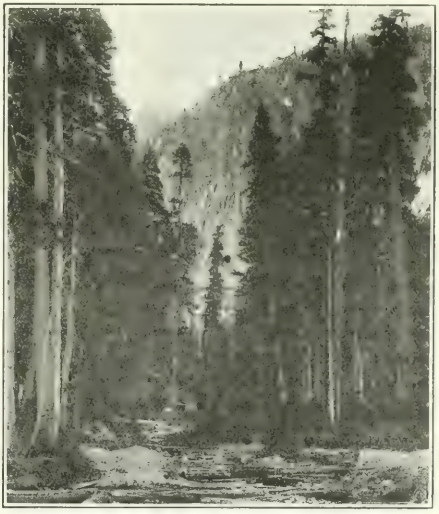
SLOCAN.—The report of the Silversmith Mines, Ltd., for the year ended May 31, 1920, shows that 13,400 tons of ore was mined during the year, producing 280 tons of shipping ore, 834 tons of lead concentrate, and 968 tons of zinc concentrate. The total income from ore and concentrate was $205,996 and the net profit $14,350. A shortage of water, due to severe frost early in the winter, necessitated the closing of the mill on December 2, and the unusually late spring prevented it being re-started before May 13. Added to this loss of five months at the mill, the mine and mill were closed by a strike for two weeks. But for these two causes the output of concentrate would have been considerably greater, which is demonstrated by the fact that since the re-starting of the mill more than $100,000 has been received for sale of concentrate. This, however, goes into next year's account. The mine is in excellent physical condition. The ore-shoot that was found on No. 10 level in 1918 has been developed on No. 8 level, where it is as strong and rich as on No. 10. It is estimated that enough ore has been proved to keep the mill running at its present capacity for the next seven years. L. H. Bigger, of Montreal, has purchased Pat McGuire's share in the Ottawa mine, and will place a mill of his own design on the property. Mr. Bigger is in Montreal financing the enterprise. Mr. Griffin and associates have found a strong vein of silver-lead ore on Lincoln creek. George Aylard and his associates in the Standard mine have taken a lease and option on the Wellington property, in the Whitewater district. The Standard mine is known to be approaching exhaustion, the vigorous development of the last two years having disclosed nothing of a lasting nature. The owners of the property, therefore, are anxious to find another mine to provide feed for their mill and employment for their staff. The last dividend was passed and some $300,000 set aside for this purpose. There is much activity in Kaslo camp.

VANCOUVER.—J. W. D. Moodie has resigned from the management of the Britannia mine, and, after a long holiday, will reside in California. B. B. Nieding, who has been operating mines in the State of Washington, has been appointed to fill Mr. Moodie's place. Mr. Moodie has been in charge of the Britannia for many years, and his foresight and energy have done much toward placing the mine in its present excellent physical state. The British Columbia 'Gazette' shows that five or six mining companies are being organized each week in this city.

PRINCE RUPERT.—H. Smith, representative of the American Smelting & Refining Co., has made an examination and sampling of the Sunrise mine, at Nine-mile mountain, which the company has under option. Prospectors are active at Kleanza mountain, near Usk; Linderland and Wells have started work on the Peerless group, at the head of Kleanza creek; Bell and Gall are developing the Sunset group. High-grade ore is being developed by J. D. Wells, at the New Era group, near Usk. To facilitate prospecting, work is to be started at once on a trail up Kleanza creek. Good samples have been taken from the Hole in the Ground group, near Prince George. The vein has been traced for 600 ft. The tunnel at the Babine Bonanza mine, in the Telkwa section, is now in 850 ft. During the last 75 ft. of driving the vein has widened from six inches to two feet, and is good milling ore.

VICTORIA.—It is understood that, owing to the high cost of labor and supplies and the unsatisfactory condition of the copper market, the Consolidated Mining & Smelting Co. will defer the erection of a concentrating plant at the Sunloch mine, about 40 miles from here. Development work will be continued at the mine. A contract for diamond-drilling has been let to the Diamond Drill Contracting Co., of Spokane, and the drills are being shipped to the mine.

STEWART.—R. K. Neil, part owner of the Premier mine,



NEAR THE BRITANNIA MINE, BRITISH COLUMBIA

in discussing operations on that property, stated that a cyanide plant, with a capacity of 100 tons per day, is being installed and would be ready for use early next year.

There are some 100 claims staked in the Marmot River district and on many, development work is in progress. George Clothier, government mining engineer, recently made a tour of inspection through the district with a view to ascertaining the extent of the necessary road and trail improvements. The B. C. Exploration Co. is heavily interested in this section and W. L. Uglow, geologist for the company, has completed an examination and is preparing a report. P. D. I. Honeyman, for the same company, has a small crew of men at work on the Salmon River Lode Mining Co.'s property, situated near the Big Missouri group. Among the properties under development in the Bear River valley are the Bayview, situated just back of Stewart, from which a trial shipment is to be made soon;

the Lakeview, which is being worked by Al. Harris on behalf of P. Welch and associates; the Fitzgerald group, which is to be explored by diamond-drill by the Algunican Development Co.; and the Nabob and Redtop groups.

Alice Arm.—The Dolly Varden is shipping an average of 150 tons of ore per day and preparations are being made for the extension of the railway to the Wolf claims situated a short distance north of the mine. The Toric, Tiger, Musk, Silver Horde, Climax, and other prospects are being opened up. Surface-stripping is being done on the La Rose group with satisfactory results and good showings are reported on the Wild Cat, North Star, and Poyal groups.

Quesnel.—Once again R. T. Ward, of the Bullion Placer Leases, has been heard of in connection with litigation. Having won his long drawn-out suit with John Hopp it was thought that the operation of the long disused property would follow without delay. Some of Ward's associates, however, challenged his right to retain control or the management of the project. For a time it looked as though there might be another sustained fight through the courts. However, it now appears that a settlement, said to be generally satisfactory, has been reached and that the well known property soon will be put on an operating basis.

ONTARIO

SILVER BEING STORED AT COBALT.

Cobalt.—At the time of writing, silver stocks at the mines of Cobalt are increasing. A total of about three million ounces of bullion is stored in the local vaults. Using cars with a capacity of 30 tons each, four such carloads of refined silver are being held pending higher prices. The Nipissing alone has nearly two carloads. It is believed that if silver producers in other countries would adopt a similar policy they would frustrate the designs of certain financial interests to hold the price of silver down. An incident of peculiar interest is the discovery of gold-bearing quartz at a depth of 800 ft. on the Crown Reserve mine where heretofore native silver has been the only precious metal. Gold assays run as high as $12 per ton, but the quantity is decidedly limited.

Oil-flotation equipment, being installed at the Temiskaming plant, is expected to be ready to operate by the end of September. Although this company has not paid any dividends so far this year, it is learned that the surplus amounts to nearly $1,000,000. This compares with $864,016 at the end of 1919. It is understood another dividend disbursement is under consideration similar to that of 4%, made in December of last year.

The construction of an 80-ton mill on the Keeley Silver Mines in South Lorrain is proceeding satisfactorily, and production is expected to commence within the next 90 days. Underground work is steadily adding to the amount of ore in sight, and the indications are that mill-heads may average between 30 and 40 oz. silver per ton.

Attracted by reports of a rich silver discovery thirty miles from Amos, in north-western Quebec, a large number of prospectors from the Cobalt district joined in a rush to that field. They allege that after examining the find, it is evident to them that the silver was placed there by human agencies.

The shaft on the Oxford-Cobalt property is to be continued from the present point of 150 ft. to 250 ft. Only lean silver ore has been found on the 150-ft. level. No silver discoveries have so far been reported as a result of throwing the Gillies Limit open for prospecting, although quite a number of claims have been staked.

Porcupine.—Figures covering the second quarter show that mining costs have been increased to a considerably greater extent than was anticipated. At the Hollinger Consolidated it was estimated that the increased rate of wages would add about 25c. per ton to the cost of treatment, but the actual increase is more than double that amount. It had been expected that the higher pay would attract larger forces, and that increased efficiency would hold the extra cost down to 25c. per ton, but the increased efficiency has not been apparent. It is realized, however, that the raising of wages was necessary in order to prevent a further decline in the number of men employed, and that otherwise the company might not have been able to 'carry-on' even at the present reduced capacity. As costs last year at the Hollinger averaged close upon $5 per ton, the figure this year will probably be about $5.50.

The McIntyre has opened up for nearly a quarter of a mile vein No. 5 at the 1125-ft. level, where it has a width of from 9 to 10 ft. with gold content averaging $18 to the ton. The orebody extends into the Jupiter claim. The shareholders of the Porcupine Vipond-North Thompson have ratified the proposed sale of 600,000 shares of treasury stock to a syndicate represented by Hamilton B. Wills. Immediate delivery is to be made of 200,000 shares at 15c., the purchasers holding an option on 200,000 more at 30c. at six months, and a further option on another 200,000 at ten months at 50c. The mine will be re-opened soon.

In the early days of the Porcupine camp Bewick, Moreing Co., an English concern, secured a large number of claims and a large block of Hollinger stock. It disposed of the latter to considerable advantage, but the outbreak of the War prevented the working of its properties. It is now stated that a new company is being organized to take over the Bewick-Moreing interests, and that financial arrangements have been effected which will enable them to operate.

Kirkland Lake.—At the Bidgood, the vein on which the main shaft was sunk dipped out of the shaft. It was tapped by a cross-cut 70 ft. in length at the 200-ft. level, where it was found to have widened out to 16 ft. A vein some distance from the shaft on the surface dipped into the workings at a depth of 240 ft. It shows a width of 25 ft. and is being sampled as the work proceeds.

Rapid progress is being made with the mill of Wright-Hargreaves, which will be the largest in the district with a daily capacity of from 150 to 200 tons. The structure is almost completed, and the equipment is being installed. Two crushers, a ball-mill, and two tube-mills are now in place.

CALIFORNIA

Bishop.—Preparations are being made to start the mill on the Wilshire gold property about the end of September. A force of 60 men has been steadily at work developing the mine since last May in order to furnish the mill with a continuous supply of ore at the rate of 150 tons per day. A body of ore 420 ft. long and about 15 ft. wide with an average gold content of $11 has been developed on the second level with ore still in both faces. Crushing will be done with an Allis-Chalmers ball-mill, which will be followed by K & K flotation machines.

Redding.—Erection of the building recently purchased from the Balaklala Copper Co. by the Shasta Zinc & Copper Co. will start at Winthrop in a short time. Dismantling of the structures at Coram, including the old Balaklala smelter, which cost upward of $1,000,000, is to start this week and the material will be moved to Winthrop as rapidly as possible. Considerable work has begun near Winthrop with more men employed as they can be obtained. The Shasta Zinc & Copper Co., controlled by the Jackling interests, has taken an option on the Arps and Michigan groups, in the Bully Hill region, and is reported negotiating for other nearby properties. On the bottom levels of the Bully Hill mine a large deposit of high-grade ore has been exposed with zinc largely predominating. Plans of the company include erection of a reduction plant and a heavy output of zinc and copper. Some silver and gold are also found.

Sonora.—Operations have been suspended at the Shawmut mine, the largest producer in Tuolumne county, by the Belmont Development Co. of Tonopah. It is stated that although the ore is of good grade with a large tonnage blocked out, the steadily mounting labor and material costs have made closing of the property advisable. A small force will be kept at work to keep the shaft unwatered and in repair. The Shawmut is one of the famous Mother Lode mines and produced millions before passing into the control of the Belmont company. Under the new control the shaft was deepened, new ore deposits opened, and mine-plant and mill greatly improved. It is stated that operations on the old-time scale will be resumed as soon as gold mining approaches its pre-war status.——A large mill has been erected on the Morning Star group, formerly the Boston, seven miles southeast of Jackson. The property contains large bodies of medium-grade ore near surface and the ground is to be worked on a large scale. The Boston was long noted for its yield of rich ore, but much medium-grade product is said to have been ignored by early-day operators. New York capitalists control the property.

IDAHO

Coeur d'Alene.—The Jack Waite company, in the Coeur d'Alene, has commenced hauling ore from its mine, 13 miles to Prichard, making two trips per day. The mine has several cars of ore ready to be hauled for shipment to the smelter. Some of the ore is first class and some hand-jigged. The ore runs 65 to 70% lead, with 5 to 7 oz. silver per ton. ——The Hecla Mining Co. is shipping 2700 to 2800 tons of high-grade crude ore and concentrate per month, according to James F. McCarthy, president and general manager. It is hoisting 600 to 700 tons daily. The mine and mill are operated on a basis of six days per week. Three hundred men are employed. The orebody opened on the 2000-ft. level of the main workings has been followed by drifting for 500 ft. It is 16 ft. wide and contains ore like that on the 1600-ft. level, the next above, in which the grade is good. The drift on this level is 1600 ft. long, considerable work having been done before the ore was reached.——Movement of ore by truck from the Idaho-Continental to the railway at Porthill, 26 miles distant, has been resumed. Four trucks are required in addition to the eight owned by the company; 1300 tons of lead-silver concentrate, slime, and crude ore has been accumulated in the period of suspended hauling, and slime and concentrate at the rate of 20 tons daily is being made. Eight trucks will haul 50 tons per day by making eight round trips. The company has a full crew of miners and shovelers, but needs mill men and several road repairmen; 125 men are employed at present.

MISSOURI

Joplin.—What is considered one of the most remarkable drill-holes ever completed in the district is that on the Acme lease of the Hurlbut land, a block of the Butte-Kansas Mining Co.'s holdings. Ore was entered in the hole at 155 ft. and continued with more or less richness to a depth of 365 ft.—or a continuous run of 210 ft. The average assay for this deposit was 6.54% zinc. Cuttings were taken from every five feet of drilling. With the exception of a few feet, the entire orebody is considered workable. The lease, a 40-acre tract, is situated west of the Waco No. 2 mill, operated by the Barnsdall interests. L. P. Buchanan of Joplin is manager of the Butte-Kansas. The discovery is a continuation of the big deposits that have been developed in the Waco field, and the orebodies are believed to be the largest yet developed in the Joplin district.

Practically the same run of ore obtained on the Butte-Kansas lease was found on the Waco No. 2 and the High Five properties, controlled by Franks and Danglade. Other big deposits have been blocked out on portions of the 400-acre tract controlled by Franks and Danglade.

Three drill-holes have been completed on the Gascho lease on the Olsen land, which show an average assay of ore of 5.98% between 300 and 350 ft. An average face of 35 ft. was developed.

NEVADA

Beatty.—The Continental Fluorspar Co., operating in the Bare mountains, has discharged all of the miners and practically has closed until new machinery can be secured. The grinder has caused trouble by the fluorspar caking in it and it is reported that clay mixed with the fluorspar has been found in larger quantity than usual in recent work. The company expects to resume in a month with a new grinder.

Cactus.—Drifts on the 265-ft., or bottom level, of the Cactus Nevada continue to open ore of erratic value, but which could be treated at a good profit in a mill on the claims. Some rich ore is being found in small lenses. The Cactus Leona is preparing to start work.

Montezuma.—The Montezuma Silver mine has been closed, the reason given being bad roads. It is rumored that a

shake-up of officials is due and that the real reason for the closing is dissatisfaction of the New York men interested with recent expenses, which are said to have been unusually heavy.

Virginia City.—An air-compressor has been erected at the place on American flat from which driving of the tunnel of the United Comstock Mines Co. will be started from the surface. The tunnel also will be driven from several old shafts. The mill to be built by the company will be constructed on American flat at the portal of the tunnel, which will be 8 ft. wide and 8 ft. high. The shafts are being put in condition so that driving can be started from them. The Imperial shaft has been sunk to 575 ft., the depth from which the tunnel will be driven. It is planned to replace the steam-hoist used for years at the C. & C., one of the north end mines, with a 400-hp. electric hoist, which will result in an estimated saving of $40,000 yearly. The vein has been entered in a cross-cut from the 370-ft. shaft of the Comstock Silver Mining Co. The cross-cut is being continued through the vein and low assays are being secured.

WASHINGTON

Stevens County.—Nine chimneys have been opened on the property of the Gladstone Mountain company, and in eight of them lead ore has been found. Some sulphide and carbonate exists in all. Chimney No. 2, in which a 100-ft. shaft has been sunk, has yielded three or more carloads of lead sulphide with a net value of $83 to $98 per ton. A carload of 46 tons, shipped recently, returned $4488 net. The carbonate ore removed from the several chimneys lies on the dump for the present. From the No. 8 chimney, a carload of lead sulphide has been shipped, another prepared for shipment, and a carload of carbonate will be shipped. This ore was removed from a shaft that penetrates the body for 20 ft. vertically and has an area of 8 by 8 ft. Some of the chimneys will be followed by shafts and others will be explored by drifts from a depth of 100 ft. The ore removed by the Gladstone in the last 10 months has supplied all the money used in exploration except that advanced to start the work and install equipment.——Several carloads of high-grade zinc ore have been mined from the vein opened recently on the Makie farm, on Deep creek, near Northport. The ore is carbonate and has a zinc content of 45%. The body is five feet wide and is not in a lime formation. Operators are proceeding with development. The comparatively short distance to a rail-point has added interest to the deposit.——The Lead Trust mine recently obtained a bond and lease on a timber claim near the mine and has found ore on it, according to reports. Ore containing lead has been disclosed at the surface and is being followed by a tunnel.

MEXICO

Sonora.—North of Las Chispas the Suiza Mining Co. is opening two shafts on the extension of the Chispas vein. One shaft is down 80 ft. and has yielded ore containing 175 oz. silver per ton. The owners of the Keystone property, west of Las Chispas, have opened negotiations to lease the Purisima claim of the Minas Pedrazzini Co., which adjoins their holdings, and have also started a cross-cut adit in the Keystone. The Espiritu Santo people have sent their engineer and geologist to inspect and report upon their claims situated south of here. The Bavicanora property, next to the Keystone, may be re-opened soon. The Ilusion, a small prospect in Las Chispas, is sinking a test-pit, that shows promising ore assaying up to 40 oz. silver and 0.5 oz. gold per ton. In the Las Chispas mine the bonanza opened last December continues to produce. Shipments of 25 to 40 tons have been made every 20 days, with assay returns ranging from 350 to 850 oz. silver and 2.75 to 7 oz. gold per ton, besides some special sulphide fine with 15,000 oz. per ton. All of this is hand-sorted ore.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

Adolph Knopf is at Mina, Nevada.

K. C. Parrish is at Barranquilla, Colombia.

Lyman H. Brooks Jr. has gone to Cooke City, Montana.

Askin Nicholas, formerly of New York, is at Brisbane, Australia.

John W. Mercer is making a short stay in Denver on his way to New York.

Charles E. Newton, of the Oregon School of Mines, at Corvallis, was here last week.

A. E. Drucker is examining copper mines in the Olympic mountains, Washington.

L. F. S. Holland is superintendent for the Crater Mining Co., at Winslow, Arizona.

John Roger, of New York, and **Walter H. Bance,** of Los Angeles, called on August 4.

H. C. Hoover is on his way from Palo Alto to Minneapolis, to attend the Institute meeting.

J. C. Vidmar, mining engineer with the Chile Copper Co. at Chuquicamata, Chile, is in Arizona.

C. B. Lakenan, general manager for the Nevada Con. Copper Co., was in Salt Lake City last week.

Clarence A. Wright, recently associated with the Salt Lake City branch of the U. S. Bureau of Mines, is in Italy.

W. H. Wellman, superintendent for the 85 Mining Co., at Valedon, New Mexico, has moved to Parral, Mexico.

W. W. Norton, superintendent of the A. S. & R. Co.'s smelter at Murray, Utah, is taking a vacation in Europe.

Ing. S. Postnikoff, manager of the Bogoslovsk mining estate in the Ural region, is visiting reduction works in Utah and Montana.

Lester S. Grant, professor of mining in the Colorado School of Mines, has been visiting mining and metallurgical plants in Utah.

P. A. Simon, president and general manager for the Simon Silver-Lead Mines Co. at Mina, Nevada, has returned from a trip to New York.

E. L. Newhouse Jr., manager of the ore-purchasing department of the Utah branch of the A. S. & R. Co., spent several days in Nevada recently.

A. G. Burritt, geologist, and **H. A. Linke,** engineer, of Salt Lake City, are making a geological survey of the Fossil oil-fields near Kemmerer, Wyoming.

T. C. Botterill, formerly assistant superintendent of the Surf Inlet mine, has accepted the superintendency of the Emancipation mine, operated by the Liberator Mining Co.

J. W. D. Moodie, for many years general manager of the Britannia mine, has resigned. He is succeeded by **B. B. Nieding,** recently with the United Verde Extension, in Arizona.

Alfred T. Hastings, formerly general manager for the Bingham-Coalition Mines Co., at Bingham, Utah, is now assistant manager for the Phosphate Mining Co. at Nichols, Florida.

A. W. Fahrenwald has been appointed ore-dressing engineer with the U. S. Bureau of Mines in charge of the Moscow station, Idaho. He is conducting differential flotation tests in the mills of the Coeur d'Alene.

George S. Rice, chief mining engineer for the U. S. Bureau of Mines, addressed the San Francisco section of the A. I. M. & M. E. on August 6. His subject was 'Liquid Oxygen as a Commercial Explosive'.

THE METAL MARKET

METAL PRICES

San Francisco, August 10

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	19.50
Lead, pig, cents per pound	8.75—9.75
Platinum, pure, per ounce	$105
Platinum, 10% iridium, per ounce	$155
Quicksilver, per flask of 75 lb.	$85
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

August 9.—Copper is inactive but firm. Lead is dull but steady. Zinc is quiet and firmer.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Date	New York cents	London pence
Aug. 3	93.75	57.00	June 28	91.41	51.69
" 4	92.75	57.12	July 5	89.97	51.68
" 5	94.50	58.25	" 12	92.18	52.66
" 6	95.50	59.75	" 19	91.04	52.91
" 7	96.00	58.62	" 26	92.39	54.77
" 8 Sunday			Aug. 2	92.85	56.20
" 9	96.00	59.62	" 9	94.58	58.39

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	....
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Date	
Aug. 3	19.00	June 28	19.00
" 4	19.00	July 5	19.00
" 5	19.00	" 12	19.00
" 6	19.00	" 19	19.00
" 7	19.00	" 26	19.00
" 8 Sunday		Aug. 2	19.00
" 9	19.00	" 9	19.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	....
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Date	
Aug. 3	9.00	June 28	8.15
" 4	9.00	July 5	8.39
" 5	9.00	" 12	8.25
" 6	9.00	" 19	8.45
" 7	9.00	" 26	8.93
" 8 Sunday		Aug. 2	9.06
" 9	9.00	" 9	9.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	....
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	....
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	....
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Date	
Aug. 3	8.05	June 28	7.85
" 4	8.10	July 5	8.04
" 5	8.15	" 12	8.15
" 6	8.15	" 19	8.24
" 7	8.15	" 26	8.22
" 8 Sunday		Aug. 2	8.11
" 9	8.15	" 9	8.12

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	....
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Date	
July 13	85.00	July 27	88.00
" 20	90.00	Aug. 3	88.00
		" 10	85.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	....
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	....
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

THE MERCHANT MARINE

Provisions of the Merchant Marine Act giving preferential rail-rates on export and import commodities carried in American bottoms are in line with practices adopted in Germany, Japan, France, Spain, and other countries, Admiral Benson, chairman of the United States Shipping Board, declared in a recent letter.

These provisions were inserted by Congress at the request of the Shipping Board, Admiral Benson said, and are designed to offset "the countless discriminations by other nations against American shipping with which the Shipping Board ships and privately owned vessels of the United States have had to contend.

"Allowing a differential export-rate lower than the domestic rate upon rail-shipments within the country is purely a domestic prerogative," the chairman declared. "Each nation may unquestionably determine for itself that such rates may be made and that they shall be limited in application to cargo carried in vessels of its nationals. The Board of Trade report to the British government made in 1918 regarding shipping policies conceded that the control of such practice cannot properly be made the subject of a treaty."

Admiral Benson's letter was in reply to one from W. T. Christensen, of Seattle, who declared that since the major part of the Oriental commerce with Puget Sound was carried by foreign vessels, the enforcement of the discriminatory features of the Merchant Marine Act might result in the diversion of that commerce to Canadian ports. Admiral Benson said that threats of foreign carriers to transfer their Pacific Coast operations to Vancouver, should preferential rates be granted for American ships, were not worthy of consideration.

"Unless American ships be substituted for foreign ships in carrying of the greater part of your Oriental commerce the shipyards of Puget Sound which have given employment to many thousands of workmen, bringing abundant prosperity to your community, must close their gates, dismiss their employees, and as an industry cease to exist. Few, if any, repairs to foreign shipping are made in American yards, nor does the use in our trade with foreign ships encourage the building of American ships in American yards, the benefits of which should be apparent to the merchants in other business interests of Puget Sound."

Discussing the giving of preferential rates in other countries, the chairman said that France had given a 20% discount upon export-freight moving in French vessels to New York and other ports, including those of Great Britain, and that Spain also was using that method along with many other preferentials in the way of subsidies and subventions with Spanish ships. "Japanese ships in the past," he said, "were able to quote the same rates to interior points in Japan as other nations were able to quote to the seaports of that country, a differential quite sufficient to have enabled them in the absence of like preferential rates within the United States for our own ships, to control the rail-routings within the United States, and they have done so in many instances to the disadvantage of American ships and at times to certain American ports."

MONEY AND EXCHANGE

Foreign quotations on August 10 are as follows:

Sterling, dollars:	Cable	3 63½
	Demand	3 64¼
Francs, cents:	Cable	7.30
	Demand	7.32
Lire, cents:	Demand	5.13
Marks, cents		2.25

Eastern Metal Market

New York, August 4.

Very little activity is reported in any of the markets. Prices are firm in most cases. Increased freight-rates are expected to advance prices ultimately.

Demand for copper is moderate for domestic consumption but fairly good for export. Prices are firm.

The tin market is stagnant, and prices are nearly nominal but steady.

Not much business is reported in lead but prices are still firm and strong.

The zinc market is lifeless and prices have declined.

Antimony is unchanged.

IRON AND STEEL

The steel trade, which indulged in some ill-starred hopes of large orders when the railroads were returned to their owners in March, is making few predictions as to the new business to flow from the large freight-rate increase granted this week, according to 'The Iron Age'. It is evident that time will be required for building up earnings and that financing will not be made easy at once.

How the freight advance will affect prices of pig-iron and of steel products is widely discussed. Some grades of pig-iron have advanced $4 in the past two months and from $15 to $18 in the past year. Fuel and transportation conditions have done this and they are still controlling factors. In comparison, the advance of $1 to $1.50 in pig-iron costs in the Middle West, due to the new freight rates, is insignificant.

Pig-iron production in July held up better than was expected in view of the railroad blockades. The total 3,067,043 tons, or 98,937 tons per day, against 3,043,540 tons in June, or 101,451 tons per day. The falling off was thus about 2500 tons per day. But July ran 2600 tons per day ahead of May and 7600 tons per day more than April. There was a net loss of nine furnaces last month.

COPPER

There has been little change in buying-power and no change in prices. Domestic consumers are not active in purchases, but foreign buyers are more so and the volume of this business is substantial. The increase in freight rates is expected to advance costs as well as freight-charges and hence the price of copper, lead, and zinc, but how, or when, no one knows. There is a possibiilty that buying for early delivery may speed up because of this, but there are no evidences yet. Leading producers of Lake and electrolytic copper maintain their prices firm at 19c., New York, for August and in some cases for September delivery. The outside market is quiet and inactive with limited quantities obtainable at around 18.75c., New York.

ZINC

Prime Western for August or September delivery has eased off to 7.70c., St. Louis, or 8.05c., New York, a decline of about 15 points in the week. This is due largely to a light demand. Buying is only hand-to-mouth and confined to a few galvanizers and brass-makers who are purchasing only for immediate needs. There is no disposition on the part of producers to sell beyond September, and some not that far, because of the effect of the new freight rates.

LEAD

The interesting news in this market is the rumor that a substantial amount of lead is on the seas from England consigned to New York. The effect of its arrival is causing speculation and it is predicted that the New York market, when offered this lead, will fall-off and may reach a level as low or lower than St. Louis. It even might reach to the level of the American Smelting & Refining Co. One cause for this opinion is the radical change in this market where the good demand has vanished and offerings of domestic lead in small quantities have been unabsorbed. Some business has been done at 9c., St. Louis, for prompt shipment and lead in transit and spot delivery has been sold at 9c., New York. We quote the market as largely nominal at 8.75c., St. Louis, or 9c., New York, with that of the leading interest unchanged at 8.25c., St. Louis, or 8.50c., New York.

TIN

There has been only enough business done to establish prices which have been relatively steady around 48c., New York, for spot Straits. Consumers still remain out of the market, which is almost lifeless. Offerings of spot-delivery Straits are light; this constitutes the only outstanding fact and it is evident that it would not take much buying initiative to send prices up. An interesting development is that speculators are letting the market drift. There was a holiday in London on Monday which intensified the dullness here, and there has been little doing since. Spot Straits there yesterday was quoted at £280 per ton with spot and future standard tin at £273 and £278, respectively. The New York quotation for spot Straits was 48.50c., yesterday. Tin arrivals in July are officially reported as 3870 tons, with 5530 tons delivered into consumption, the amount in stocks and landing July 31 having been 1926 tons. Arrivals thus far in August have been 1910 tons with 3065 tons afloat.

ANTIMONY

The market is unchanged except that there is a pressure to sell spot stocks. Quotations for wholesale lots for early delivery are 7.25c., New York, duty paid.

ALUMINUM

Conditions are nominal with quotations unchanged at 33c. from the leading interest and 31.50c., New York, from other sellers for virgin metal, 98 to 99% pure in wholesale lots for early delivery.

ORES

Tungsten: As compared with recent weeks a fair business has been done and negotiations for further business are reported. Chinese ore is quoted at $5.25 per unit with Bolivian ore at $6.50.

Ferro-tungsten is quoted at 80c. to $1.10 per pound of contained tungsten.

Molybdenum: The market is quiet with inquiry somewhat better. Sellers are asking 75c. per pound of MoS_2 in regular concentrate with 60c. offered.

Manganese: Quotations are nominal at 70c. per unit, with offerings at 75c. Importations in June are officially reported as 80,329 gross tons or the largest in many months. This brings the total for the first half to 216,542 tons, or 36,090 tons per month.

Manganese-Iron Alloys: Offerings of Japanese ferro-manganese are reported to have eased off the spot quotation, which has been $225, delivered. This foreign alloy is offered at $185 seaboard. The last half quotation is still $300, delivered. Inquiries are few, although some small prompt lots have sold at $225. Importations in June were 5694 tons or the largest in many months. Exports were 275 tons in June, making the total for the fiscal year 2374 tons against 2184 tons for the fiscal year of 1919. The spiegeleisen market is stronger with $80, furnace, asked and with inquiries totaling 3000 tons and 600 tons sold to domestic consumers.

INFORMATION FURNISHED BY MANUFACTURERS

MINING NITRATES IN CHILE

By P. A. Raymond

Chile has been producing nitrate from its northern pampas for more than 50 years. It is natural that in the beginning the work was done in a primitive way, both with reference to extraction and elaboration. Of late years improvements have been made both in the transportation of the raw material to the elaboration plant and in its elaboration, but the methods of drilling and blasting has changed but little. The nitrate is produced from a material known in Chile as 'caliche', which lies in a horizontal stratum covered by an overburden of 'costra' and sometimes other rock. Costra is a rock that is impregnated with nitrate and might be considered a low-grade ore. The formation is broken, and contains seams, fissures, and vug-holes. The method of working has been to open up trenches, locally known as

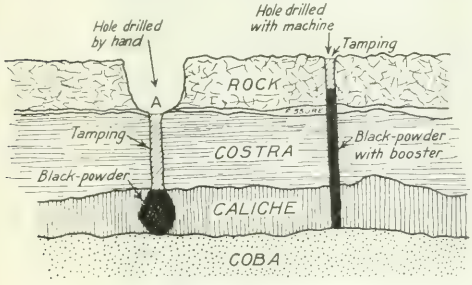


Fig. 1. Methods of Mining Nitrate

'rajos'. These trenches are then widened, making a quarry-like hole called a 'calichera'. The depth of the trenches depends upon the depth of the strata or caliche or costra, ranging from 6 to 30 ft. The method is to go back from the face from 6 to 18 ft., according to conditions, and drill a hole as shown in Fig. 1.

These holes are dug by hand in the following manner: A hand-drilled hole is put down to the point marked 'A'; it is blasted and cleaned out. Then the driller proceeds to dig a hole from 6 to 8 in. diam. until he strikes the caliche, after which he forms what is known as a 'tasa', which gives the same condition as a sprung hole in quarry work. The tools used are a single-hand hammer, hand-steel, punch-bars with points formed at different angles, and a steel spoon 3 or 4 in. diam. fastened to a stock 6 to 12 ft. long. The hole is afterward loaded with black-powder as shown in the sketch mentioned. The above work represents from 2 to 6 days for one workman, and will break from 700 to 1000 cu. ft. of material, leaving many large boulders which are afterward block-holed by hand or broken up with a 16-lb. double-hand hammer. This material is afterward sorted by hand by men who work at a certain price per carload, the barren rock being thrown to one side.

About two years ago the Allied Machinery Co. of America sent a representative to Chile, and he, like many others, saw the big opportunities for the use of steam-shovels, drag-line scrapers, etc. After looking over the conditions he succeeded in placing two steam-shovels of the Thew automatic portable type for handling old worked-over material, but, like other engineers, he found himself handicapped with the problem of drilling and shooting the material in place sufficiently fast to make a shovel work efficiently. It will readily

Native Workman and Turbro Drill

be seen that 1000 cu. ft. of material drilled and shot in three days will not keep a shovel busy.

Manufacturers of drills in both Europe and America had tried to solve the problem. Nearly every type of drill, including piston-drills, hammer-drills, churn-drills, and diamond-drills had been tried and all failed for one cause or another. The water question eliminated the piston and churn-drills, the hammer-drills failed for the reason that in all hammer-drills the rotation was dependent on the action of the hammer, causing the steel to stick when striking open fissures, vug-holes, or hard pebbles.

I made a visit last August to some eighteen or twenty properties and I wish to say that every assistance was given by the Chileans toward a thorough study of the question. After going over the data, including the reasons for previous failures, it was decided to try out the Turbro drill, manufactured by the Denver Rock Drill Manufacturing Co. of Denver, for the reason that it is of a portable type (plain tripod-mounting), and that by a small change in the air-connections it could be made to use compressed air instead of water through the steel to expel the cuttings. Moreover, the rotation is independent of the action of the hammer or piston.

After the manager of the Peña Grande property, owned by the Dupont Nitrate Co., was good enough to agree to allow us to use compressed air from its power-plant, reports and recommendations were sent to the Denver Rock Drill Co., specifying steel for holes 6 in. diam. A Turbro drill with tripod and different types of drill-bits were sent to Chile for experimental work. This equipment arrived about January 1 when work was started. As the nitrate producers, due to old established customs, insisted on large-diameter holes, it first was attempted to drill 6-in. holes.

Mining Nitrate in Chile

This was a failure for many reasons. The large bits that were tried lost gauge quickly, due to the heating in dry drilling, and the excessive friction caused by rotating in a large circle. Also, the larger the hole the more susceptible to caving; and most important of all, the larger the hole the more power was required, not so much to cut the rock as to keep the hole clean of cuttings. For example, in drilling a hole 6 in. diam. at the rate of 5 in. per minute, there is about 400 cu. in. of loose cuttings to be expelled per minute in order to keep the hole clean.

Different types of detachable bits were tried, as a detachable bit is particularly desirable, due to the fact that the work generally is some distance from the blacksmith-shop. It is interesting to note that the best results were derived from the old cross-bit, commonly used in mining all over the world. The size of bits finally adopted was 3¾-in. starters, finishing with 2¾-in. at a depth of 9 ft. The Turbro drill in its construction had a great advantage due to its independent rotation. On several occasions the drill went through soft broken material by rotating the steel only. The bit could be extracted readily when it became time to change from one length to another.

After considerable experimental work a trial was made under working conditions, with the following results: The operator connected his machine to the air-line and proceeded to drill five holes, 9 ft. apart, at the points spotted by the superintendent of Rajos. These five holes were drilled in 5 hours and 15 minutes, making a total of 53½ ft. The time included setting-up and moving from one hole to another. The cost, including labor, power, and lubrication, was $2.01 Chilean currency, as compared to $3.97 per foot drilled by hand.

This represented the necessary drilling for the breaking of approximately 5000 cu. ft. of material, as compared to 1000 per hole drilled by hand. While the difference in cost is encouraging, that is not the most important item to be taken into consideration by the American manufacturer or the nitrate producers themselves. The point of interest to both is that this shows a large increase in material produced per man.

The question of blasting was also studied. It is a simple shallow-quarrying problem, in fact the loading of the holes with smooth walls properly tamped, using a booster in form of a cartridge consisting of a stick of 62% dynamite, 3 by ½ in. and a No. 6 cap, gave as good results as hand-drilled holes loaded as shown. This plan also lends itself to simultaneous blasting with a battery, which had never been used before. It was not customary even to put a cap on the end of the fuse in the old method of working.

The object of shooting in front of any apparatus for moving dirt mechanically is to loosen it. A certain proportion of the material is left in the form of boulders. These were block-holed by using a small drill made by the same manufacturer, known as the Clipper. The cutting speed and portability of this machine can be appreciated from a trial run which gave twelve holes per hour at an average depth of 12 in. per hole.

Bulletin LD-101, issued by the Edison Lamp Works, discusses maintenance of lighting systems.

T. A. RICKARD, - - - - Editor

DR. VON SIMMONS, the Secretary for Foreign Affairs at Berlin, said, at the opening of the National Assembly: "German-American official relations will not be changed before March 1921." Perhaps. Meanwhile in England it has been announced that by Order in Council the date of the termination of the war with Germany was fixed as January 10, 1920. The Armistice was signed on November 11, 1918!

IN the latest issue of our New York contemporary we note a letter, signed 'X', on the subject of metal quotations. The writer of this letter says: "From the standpoint of the trade I therefore consider that the 'Journal' is the best-fitted agency to determine the average price of lead." This might be interesting if the writer had signed his name instead of hiding as an unknown. The editor might have insisted upon a proper signature to this letter instead of interjecting a foot-note about "mud-slinging editors", which is merely a childish expression of spleen. The opinion of Mr. X that the 'Journal' is best fitted to quote accurate average prices for lead, or for other metals, is unimportant as against the recent confession of the editor of the 'Journal' that he cannot give accurate quotations, and that he would like to delegate the task to Mr. X or Mr. Y.

CALIFORNIA ranks first among the States in the variety of mineral substances that are produced on a commercial scale, and except for four Eastern States, where iron and coal are mined in great quantity, it leads in the gross value of mineral production. For 1919 this amounted to $196,473,560, according to statistics recently prepared by the State Mining Bureau. Fifty different substances, of which eleven, in the crude form, were valued at more than a million dollars each, are included in the list. California is the only State that produces borax, and it supplies three-quarters of the domestic output of mercury. It leads in gold and platinum; it competes with Colorado for first place as regards tungsten and with Oklahoma in its production of petroleum. Crude-oil is by long odds the most valuable product, 101,182,962 barrels, worth $142,610,563, having been mined in 1919. Gold takes second place, the value being $17,335,100. Less than 3000 tons of coal and only 2300 tons of iron were mined. There was a marked reduction in the output of most of the metals as compared with 1918. The production of copper decreased to less than half, of lead and tungsten to approximately one-tenth, while the value of manganese fell from almost a million to $450,000. Quicksilver diminished one-third in quantity and one-half in value, but even then was worth $1,353,381.

ANNUAL reports of mining companies usually give the names of the president, vice-president, and directors; they also state the names of the secretary, treasurer, and so forth, but they omit sometimes to record the man upon whom, more than any other, the success of the enterprise depends—the manager at the mine. We have received the annual report of the Howe Sound Company, for example. The names of various important and unimportant persons appear in handsome print on expensive paper, together with a statement to the shareholders signed by the president of the company. Nowhere, not even in the president's report, is there any mention of the manager or of any member of the technical staff. The Howe Sound Company owns the Britannia, one of the finest copper mines in the world and a highly technical undertaking, as we happen to know well, because we have been there. One would suppose from the report that the assistant-secretary and assistant-treasurer were more essential to the prosperity of a mine and mill than the superintendent of either one or the other. If the shareholders are wise they will show some reasonable curiosity in regard to the personnel of the staff at the vital spot as well as in the office at New York.

THOSE of us with an abiding faith in the proposition that 'nothing is, that is not useful', especially if we happen to have supersensitive olfactory nerves, may find consolation in some experiments conducted by the Bureau of Mines whereby the malodorous properties of certain substances are put to practical use. Various schemes have been tried for warning miners in remote mine-workings of fire or other danger; the difficulties are obvious. The tests made by the Bureau in the Speculator mine at Butte, and in the North Star and Empire mines at Grass Valley, California, demonstrated that a signal could be transmitted a distance of as much as a mile in less than five minutes by introducing certain chemicals into the pipes conveying compressed air to the working-places. A pungent gas is formed that mixes with the

compressed air and circulates with it to the most remote parts of the mine. To be suitable the gas that makes the stench should be harmless; it should not irritate the eyes, for fear of hindering the miner from finding his way; it should have a high vapor-pressure, to permeate widely; and, lastly, it should be disagreeable as well as distinctive, so as to compel attention. Butyl mercapton, ethyl mercapton, and amyl acetate are, in order, the most satisfactory substances. The last is artificial banana-oil and is rather pleasant, which, according to the Bureau engineers, is not in its favor.

ON his return from Scotland, Dr. Victor C. Alderson, president of the Colorado School of Mines, made sundry interesting remarks on the oil-shale industry. The Scottish shale, he says, yields 20 barrels of oil per ton, this being half the yield from American shale. Even at that the Scottish shale affords a net profit of 50 cents per ton, despite the fact that the mining is done by hand and that wages are about $4.50 per day. The retort used in Scotland is not suited to our Western shale; out of 14 types of retorts only one is at all adapted to the beneficiation of the shale deposits in Colorado, Utah, and Wyoming. Dr. Alderson states further that crude oil can be won from shale at $1.85 per barrel in Colorado and Utah, where 5500 square miles of such rock is available for exploitation. A yield of even one barrel of oil per ton of shale represents a fabulous output. One 10-foot bed of shale, at one barrel per ton, represents over fifteen million barrels of oil per square mile of shale. The production of petroleum from wells in this country to date has been obtained from 4109 square miles, the estimated yield having been 2,280,000 barrels of oil per square mile. These are big figures. We hope that Dr. Alderson will succeed in stimulating intelligent interest in the subject. We note that the Comptroller of the Currency speaks of "the limitless oil-shales of the West" in context with our resources in water-power.

DEFLATION of prices is in progress, as most of us have begun to discover, not without satisfaction if it concerns the things we buy, and not without chagrin if it concerns the things we sell. The Federal Reserve banks are using gentle but effective means for restraining further gambling in merchandise; and some people have become sadder and wiser, while others have become more cheerful, but no wiser. Mr. John S. Williams, Comptroller of the Currency, says: "The deflation and subsidence in prices is proceeding by orderly and satisfactory steps and methods." Deflation usually involves some crinkling, and subsidence some cracking, but the operation, like that of the surgeon, is highly satisfactory even if the patient feels somewhat piano for a time. The slowness of the process, we are told by the knowing ones, gives the best evidence that it will proceed safely. It is over-due, but we trust this will not intensify the unpleasant symptoms, such as are recorded in the list of bankruptcies. One splendid feature of this economic crisis, impending ever since the Armistice, is the strong position of the banks, National and State, as shown by Mr. Williams in his recent address before the Maine Bankers Association. To the establishment of the Federal Reserve system our entire economic structure is greatly indebted for moral, as well as financial, support. Thanks in large measure to it, as Mr. Williams says, "we have the right to look to the future with confident hope".

ACCORDING to news in the latest Australian mail the leaders of the strike at Broken Hill profess their belief that an early settlement is possible. This was a month ago, however, and as yet the cables have not apprised us that work has been resumed. The strike, which began in May 1919, is one of the most protracted and bitterly waged industrial disputes on record. While only about 2500 miners are directly concerned, their refusal to work has affected more than 20,000 employees, whose income has been largely stopped for fifteen consecutive months. In spite of widespread suffering, which we are told entailed actual starvation, the men have refused stubbornly to accept the terms offered by the employers. The demands include a six-hour day, a five-day week, the abolition of both the contract system and night work in the mines, and a minimum wage of £1 per day. With respect to the contract system of payment, we believe the miners are in the wrong; likewise we fail to see reasonable grounds for insisting on a five-day week. The workmen point to the extremely large dividends that were paid during the period of the War, and decline to believe the contention of the companies that they would be unable to operate at a profit under the conditions for which they are striking. Just what concessions the employers are prepared to make we do not know, but there should be a basis on which both sides could see their way to a resumption of an industry that heretofore has produced silver, lead, and zinc to the value of five or six million pounds sterling annually.

A SUBSCRIBER writes asking for a list of "the six largest mines in the world, that is, those mining and milling the largest tonnage, in the year 1917". This has incited us to delve into some statistics, with sundry interesting results. The eleven companies that mined the greatest amount of ore during 1917 are, in their order, Utah Copper, Anaconda, Nevada Consolidated, Inspiration, Chino, Ray, Calumet & Hecla, Chile Copper, Alaska Gold, Crown Mines, and Randfontein Central, the last two in South Africa. The iron-mining companies are not included in the comparison, although it may be mentioned that the Oliver Mining Company, from its group of properties in Michigan and Minnesota, mines 25,000,000 tons in the course of a year. Perhaps our seeker after information will object to the inclusion of Utah Copper on the ground that its steam-shovel operations make it a quarry rather than a mine, more like the pits of the iron ranges than his notion of a hole in the ground from which ore is hoisted. Other mines of the disseminated copper group belong to the same category, but the word 'mine' is not limited by any such restriction. A

mine is an excavation in the earth from which mineral is removed. An oil-well, a salt cavern, a sulphur bore, a glory-hole, an open-cut for hydraulic operations, a series of terraces for steam-shoveling are different in kind but they are all veritable mines. Our inquirer may even demur to the classification of the Anaconda as a unit because of the fact that the company actually operates a score of mines at Butte, although one can descend the High Ore shaft at the northern end of the district and emerge from the Original in the heart of the city after having traveled through workings wholly within Anaconda ground. However, a mine is not limited to one shaft or to one claim; it is a unit if it belongs to a single proprietary. Probably, however, the single shaft through which the most copper ore is hoisted is that of the Inspiration. We give herewith the record of tonnage in 1917 for several groups of mines:

Disseminated Copper	
Utah Copper	12,542,000
Nevada Consolidated	4,064,000
Inspiration	3,891,000
Chino	3,608,000
Ray	3,560,900
Chile Copper	2,904,000
Braden	1,750,000
Miami	1,640,000
Michigan Copper	
Calumet & Hecla	3,159,000
Quincy	1,280,000
Ahmeek	1,271,000
Osceola	1,237,000
Other Copper	
Anaconda	4,300,000
Copper Queen	1,277,000
South African Gold	
Crown Mines	2,100,000
Randfontein Central	2,017,181
East Rand Proprietary	1,700,000
Miscellaneous	
Alaska Gold	2,240,346
Homestake	1,677,623
Rio Tinto (1913)	1,859,571

The Polish Muddle

The impression prevails that Poland tried to get a home-run on a foul. Nobody could have dreamed three years ago that the painful work of reconstruction after the War would be imperiled by fighting between Russia and Poland. At that time Poland was crushed to earth and Russia was in the hands of madmen. One of the first fruits of the Treaty of Versailles was the restoration of Poland as a nation and the fixing of boundaries that gave the Poles the territory to which they were entitled ethnically, in accord with the ideas of national self-determination that were awakened during the great struggle with Prussian piracy. The countrymen of Kosciusko and Paderewski wanted more, they aimed to restore the vague outlines of the Polish kingdom of 1772, but their importunities had to give way to the greater need for establishing a European peace. Most of us were sympathetic, the American Relief organization gave prompt aid to the hungry, and one of Mr. Hoover's best stories was the one in which he told of the 45,000 barefooted children at Warsaw that passed in review before him in order to express their gratitude. Meanwhile there was talk of Poland becoming a buffer against Bolshevik incursion and of serving as an obstacle to German exploitation of Russia. The Germans and the Bolsheviki were the bogies of civilization; anything that would circumvent them was well worth while. Germany had her revolutions and counter-revolutions. Interest was diverted from Warsaw to Berlin. Then in May of this year we began to hear about the Polish campaign in Russia, Poland was on the aggressive, a strong army had been mobilized and was about to seize the Ukraine. It might be a crime, but it was being done against the criminal Soviet republic, and that made it almost respectable. So there was but little protest. The government of Lenin and Trotzky was about to collapse in any event and the Ukraine would be happier under Paderewski, of Pilsudski, or whoever was in control at Warsaw, than under the bloody tyrants at Petrograd. Here we may refer to the fact that of all the subjects that have been darkened by misinformation there has been none so obscured as Russian affairs during the last five years. The columns of the great newspapers of London and New York, for example, have reeked with rot; there have been enough silly books written on Russia by ignorant reporters and stray litterateurs to fill a library; the telegraphic dispatches from "our own correspondent" have been ludicrous in their contradictions. One reason is that few people know the Russian language; another is that prejudice for or against the Bolshevist regime has stupefied the judgment of those who have written on Russian affairs. For ourselves, we believe that outlaws to civilization are in the saddle at Petrograd and that the welfare of the world will be furthered by making an end of them; nevertheless, that does not excuse Polish invasion, which was prompted by territorial greed. The Poles having failed in their banditry, now play the baby and make an appeal "to the conscience of the nations"; they are screaming that the fall of Poland will be "due to the indifference of a world which calls itself democratic". This is shameless effrontery. The Polish Counsel of National Defence, from whose proclamation we quote, also says that "Bolshevist victory on the Vistula threatens all Western Europe". It may be true, and the probable truth of it introduces a complication of which the Poles and their friends are making the most. Of course, the Bolshevists intend to organize a Soviet at Warsaw; and that in turn will serve as a new outpost for Bolshevist propaganda in Germany. The menace is plain.

At the critical moment, on August 10, our government through the Secretary of State, Mr. Bainbridge Colby, in a note to the Italian ambassador at Washington, stated the policy of the United States in unequivocal terms. The hope is expressed that an armistice may be arranged and the territorial integrity of both Poland and Russia respected, but "this country strongly recoils from the recognition of the Bolshevik regime". The government and people of the United States desire to help the Russian people and are unwilling that while "in the grip of

a non-representative government, whose only sanction is brute force, Russia should be weakened still further by a policy of dismemberment, conceived in other than Russian interests". The whole pronouncement, as made by Mr. Colby, is strong and sane. It has decided moral value, even if "the employment of all available means to render it effectual" prove, under the circumstances, only an academic phrase. It is extremely unlikely that the government of the United States will be willing to use either naval or military force to assist Poland at this time. On the same day, Mr. Lloyd George, speaking for England, said that the Polish attack on Russia was not justified and that it was made despite the warnings of the Allies, but that "nothing justifies retaliation, reprisal, or punishment which goes to the extent of wiping out national existence". In other words, the independence of Poland must be preserved, because "its existence as an independent nation is an essential part of the structure of European peace". He himself had been negotiating with Mr. Leonid Krassin, an emissary of the Soviet government of Russia, whereas the French government allowed it to be known on August 12 that it had already agreed to support General Wrangel, who has set up a military government in the Crimea and is battling with the Bolshevists. The reason given by Mr. Millerand, the French premier, is the traditional friendship between France and Russia, whereas the reason given by rumor is the undertaking of General Wrangel to recognize the debts incurred by Russia to France during the Czarist regime. It is a pretty mess. The complexity of the muddle is increased by the fact that the Russian armies are commanded by officers of the old Czarist army and by many of those who served under the Kaiser, whereas the Polish armies include numbers of Frenchmen, Britons, and even some Americans. The Great War of 1914-1918 has been followed by a hideous nightmare in which brave soldiers from the various armies find themselves fighting under unaccountable alignments. One thing is clear: the Polish attack has aroused the national spirit of the Russians and rallied them for the moment under the leadership of Trotzky, *alias* Braunstein, a German Jew, and Lenin, *alias* Ulianof, a Kalmuck. The Czarist officers answered the national call and the young men have enlisted in the army largely because military service ensures them better food and clothing than the civilian population can obtain. The Poles, instead of checking Bolshevism, drove the Russian people to the support of the Bolshevist regime. Instead of serving as a rampart against the savagery of the anarchist, Poland has become an excuse for a further onslaught upon Western civilization. That menace outweighs the plight of Poland, much as we may deplore it. If Bolshevism overwhelms Poland, it will inundate Germany. Civilization is on the defensive. The best way to kill Bolshevism is to let the Russians stew in their own juice; if they come beyond their own borders they must be driven back, but to invade Russia is to strengthen the Bolshevist regime, which would have collapsed ere now if foreign interference had not rallied national sentiment to its defence.

Federal Trade Commission and Minerals Separation

In this issue we publish the record of the testimony given by the editor of this paper before the Federal Trade Commission, which is hearing a complaint against the Minerals Separation companies. We have omitted some of the irrelevancies and immaterialities, and corrected some obvious errors in the reporting of the colloquies between the witness and counsel, but we believe these minor omissions and changes will meet with the approval of counsel on both sides. The Minerals Separation people were given an opportunity to expose the shady past of the witness and to prove the sinister influences that have controlled his public criticism of their doings. They did their best and failed utterly, of course, because there was nothing to uncover. A petty fuss was made over an editorial that appeared in the 'Mining Magazine' of May 1912. That editorial was rather friendly, than otherwise, to the Minerals Separation people, so Mr. Nutter challenged the editor of the 'Mining and Scientific Press' to re-print it, on the supposition that the editor of the 'Press' had written the editorial in the 'Magazine', and therefore had exhibited gross inconsistency as between his attitude in 1912 and in 1917. As the testimony shows, the editorial of 1912 was written by Mr. Edward Walker, assistant to the editor of the 'Mining Magazine', not the editor himself. At that time the interest in flotation affairs was small, the process was relatively unimportant, the mining profession had but little curiosity concerning it, and had heard of it chiefly through the story of the miserable quarrel between the Elmore brothers and the firm of Sulman & Picard. Sundry points in patent law had arisen and sundry litigations were in progress, but they were not deemed in any sense vital to the mining industry. Mr. Walker, a resident of London, had given some attention to the subject previously and to him naturally was delegated the writing of the editorial upon the organization of an American branch of the Minerals Separation company. We reproduce Mr. Walker's article on page 279. Naturally no reason existed for the re-publication in the 'Mining and Scientific Press' of an article in another paper written by a gentleman in no way connected with the 'Mining and Scientific Press'. We have omitted the interrogatory concerning a correspondence between the witness and Mr. Ballot, because it has no significance, except to show that they could exchange letters politely, and that, although the witness consistently opposed the exactions of Minerals Separation, he was still on such terms with the chairman of the company as showed that there was no personal animus and no underground motive for his criticism. The record of this small part of the proceedings suggests how much time is lost in aimless questioning, it being evident that counsel for the Commission did not know what testimony the witness could give that bore upon the complaint, and was engaged chiefly in a fishing expedition. It remains to extend our compliments to counsel for the respondents and express the regret that the clever lawyer is so often on the wrong side.

Minerals Separation Before the Federal Trade Commission

Excerpt From the Record of Proceedings

THOMAS ARTHUR RICKARD was thereupon called as a witness, and, having been duly sworn, testified as follows:*

DIRECT EXAMINATION

BY MR. HAWKINS:

Q. Will you please state your name, Mr. Rickard?

A. Thomas Arthur Rickard.

Q. And where do you live, Mr. Rickard?

A. Berkeley, California.

Q. What business are you engaged in?

A. Editor.

Q. What are you editor of?

A. The 'Mining and Scientific Press'.

Q. What is that?

A. It is a professional weekly publication—[spelling it] w-e-e-k-l-y.

Q. To what extent is it circulated, where is it circulated?

A. It circulates as widely as it can, and that is around the world.

Q. Does it circulate to any particular class of people?

A. It circulates among those engaged in mining and metallurgy.

Q. What has been your engineering education, if any, Mr. Rickard?

A. I am the son and grandson and great-grandson of a mining engineer. I was graduated from the Royal School of Mines in London in '85, when I came to Colorado, and there I was engaged as an assayer, surveyor, mine manager, and consulting engineer, successively.

Q. In 1905?

A. In 1885. I was State Geologist for Colorado for three terms, under three different Governors.

Q. Are you the author of any books, text-books, or books on mining engineering?

A. Yes, seven or eight books.

Q. What are they?

A. 'The Stamp Milling of Gold Ores', 'Pyrite Smelting', 'The Copper Mines of Lake Superior', 'Journeys of Observation', 'Through the Yukon and Alaska', 'Flotation', 'The Flotation Process'. There are others, the names of which I don't recall for the moment.

Q. What has been your experience with flotation and the flotation process?

A. I am familiar with it in a general way, and I have read what others have written. I have visited a number of mills where it is in use, I have watched it in operation, I have made minor experiments on my own account in order to try to understand the physics of it, but I am not a specialist or an expert; I am an editor.

Q. Have you made any study of it other than you describe?

A. I have made a study of it for the purpose of understanding the litigation, the processes, and the writings of other people.

Q. Now, in your study of it what sources of information have you used?

A. I have gone to those who were directing flotation operations, I have gone to specialists and have asked them for light on the obscure phases of the subject. I have been to a large number of mills where it has been in use, and, as I have said, I have conducted some of the elementary experiments that are needed to understand the phenomena of surface-tension.

Q. Are you the author of any literature on flotation other than the books you have described, any articles?

A. Yes. I have written a number of articles by way of comment and criticism, as editor of the 'Mining and Scientific Press', and I may add, in order to win a smile from the very solemn face of Mr. Nutter, that in 1918 I was asked by the 'Encyclopedia Americana' to write the article on 'Flotation', and I took great pleasure in doing so. Now [beckoning to Mr. Nutter, who thereupon did smile]; thank you.

Q. What is your familiarity with the articles in mining magazines written by other authorities on the subject of flotation?

A. Well, I have published a great many of those articles myself, and I always revise carefully anything that I publish. I have also read articles written in other magazines by other people.

Q. You said you came to this country when?

A. In 1885.

Q. How did you become acquainted with Mr. Ballot?

A. I was editor of the 'Engineering and Mining Journal' in 1903, and then I came here and obtained the control of the 'Mining and Scientific Press' in 1905, because I wanted to be an independent editor, and I didn't have enough money to buy the 'Mining Journal', but I did have enough to buy the control of the 'Press'. In 1909, on the invitation of a number of mining engineers, some of them Americans, I went to London to start 'The Mining Magazine', and while there I made the acquaintance of the principals in Minerals Separation: Mr. Sulman and Mr. Picard, who were among the leading mem-

*The Commissioner and presiding officer is Houston Thompson. G. R. Hawkins and Claude R. Porter are attorneys for the Federal Trade Commission. Alfred A. Cook is counsel for the respondents, the various Minerals Separation companies.

bers of the profession. Mr. Curle, one of the directors, was one of my very best friends, and he is still—I believe I am not his, but he is mine—and I also made the acquaintance of Mr. Ballot, through Mr. Curle.

Q. Are you acquainted with their policy, or were you at that time, with reference to the restriction of the dissemination of knowledge with reference to the art of flotation?

MR. COOK: That is objected to as irrelevant and immaterial.

COMMISSIONER THOMPSON: Whose knowledge? You don't say in your question.

BY MR. HAWKINS:

Q. Were you familiar with their license agreement, of the Minerals Separation?

A. I was not then. Not when I was in London. I have become so since.

Q. Are you familiar with it now?

A. I have seen copies of it since then.

Q. I hand you a copy of Exhibit 46-L, which is a copy of the license agreement, and call your attention to clause 9 of the last sentence. Now, will you tell us whether during the time you were in London, the Minerals Separation Company had a clause of that character in their license agreement?

A. I was not aware of it, but I was aware of the extreme paucity of information available concerning the technology of the process.

MR. COOK: I move to strike that out as not responsive.

COMMISSIONER THOMPSON: We will let it go in.

BY MR. HAWKINS:

Q. What did you inquire for?

A. I inquired for information that I thought would be of benefit to those who would be likely to use the process.

Q. What did you want the information for, for personal use, or to publish?

A. To publish in 'The Mining Magazine', of which I was then editor.

Q. You spoke regarding Mr. Hoover's book.

A. Yes.

Q. It was published by 'The Mining Magazine'?

A. The Mining Publications Company; that was the holding company. We published the book for Mr. Hoover.

Q. What year was it that you published Mr. Hoover's book?

A. The book was published in 1912.

Q. Did you ever have any talk with any of the officials of the Minerals Separation with reference to its publication?

A. Yes. When Mr. Hoover offered me the manuscript of his book, I realized it was a book for which there would be a big demand. I knew he was extremely well fitted to write such a book at that time. Therefore I was very glad to get it. When I looked through his manuscript, I found certain parts that seemed to me not suitable for publication, especially the chapter that dealt with patents. I submitted to Mr. Hoover that he should not publish this part of the book.

MR. COOK: I object to the conversation between Mr. Hoover and the witness. He was not in the employ of the Minerals Separation.

COMMISSIONER THOMPSON: Sustained.

BY MR. HAWKINS:

Q. State what your conversation with the Minerals Separation people was.

MR. COOK: I object unless the particular person or persons of the Minerals Separation Limited with whom Mr. Rickard had talked are mentioned.

COMMISSIONER THOMPSON: You can name the persons in the Minerals Separation, the names of the persons with whom you discussed the matter, and then you can state what you discussed.

A. John Ballot and J. H. Curle.

BY MR. HAWKINS:

Q. What was said at that time, at that conversation, by you and by them?

A. Having made up my mind that the book could not be published without the consent of these gentlemen—

MR. COOK: I move to strike that statement out of the mental operation of the witness.

COMMISSIONER THOMPSON: The witness may proceed.

MR. COOK: Exception.

A. (continued). I told Mr. Hoover I would not be a party to the publication of the book without the consent of his former employers, but that I would try to get their consent.

BY MR. HAWKINS:

Q. Why was it necessary for you to get the consent of Mr. Ballot and Mr. Curle?

A. Because I knew that Mr. Hoover had been in their employ, and I thought it was the proper thing for him, as a professional man, to get their consent; otherwise he would lay himself open to the charge of disloyalty that had already been made against him in *ex parte* proceedings. So I went to see Mr. Ballot and Mr. Curle and pointed out to them that if they would be reasonable, if they would give their consent, Mr. Hoover would probably delete parts of the book that should not be published, and if they were unreasonable he would probably publish it elsewhere; that I would not myself publish it unless they gave their consent. I advised them in the most friendly way to be reasonable, otherwise they might have a great disservice done to them; and so it was arranged that the manuscript of the book should be submitted to their patent lawyer—I think he was called Ballantyne—and Mr. Hoover acted most frankly in the matter and agreed that this inspection should be made. The manuscript was sent to New York, to Dr. Gregory, I was told, and they had a cat-and-dog time of it for three or four months—

Q. A cat-and-dog time—what happened, if you know?

MR. COOK: Were you present when they had this cat-and-dog time?

A. I was present at echoes of it, in conversations. What we did finally was to accept the manuscript, with many alterations and corrections in red ink, which

marked the exceptions taken by the experts of the Minerals Separation to portions of the text. Those corrections were all accepted in good faith by Mr. Hoover, and by me, as publisher, and the book was forthwith published.

By Mr. Hawkins:

Q. Do you know of any other instances in which they have censored publications on flotation?

A. Yes, most assuredly, in my own case.

Q. Tell us of that.

A. In 1915, returning here, I saw the importance of the subject and undertook to publish matter on flotation. Among others I went to see Mr. Charles Butters at Oakland.

Q. Who is he?

A. Mr. Butters is a well-known mining engineer, a metallurgist of high standing, and a man of international reputation. I went to see him because he was an old friend of mine and because he had a laboratory in which a Minerals Separation machine was in operation. I was curious to learn all I could about the process, and I decided that a good way of eliciting information for public use would be to interview him. He consented to be interviewed; this was in July 1915. He gave some interesting information concerning his own experiments. Soon afterward Mr. Nutter came to my office and asked me whether I had some such article or interview in preparation for publication, and I acknowledged at once that I had.

Q. What was the character of this information that you were going to publish?

A. Well, the interview itself concerned Mr. Butters' past experience in metallurgy, and gave his opinion as to the importance of flotation at that time, and as to its applicability to various ores. So Mr. Nutter came to me—I had known him in the most pleasant way for many years—and he asked me whether I had this article. I said "Yes"; so then he said, "I have got to raise a red flag" —a curious phrase—I knew the meaning of it, of course. I said to him, "Excuse me for a moment if I do not answer, because I am angry." So I waited for an interval, and then asked him "You undertake to warn me not to publish this article?" He said, "Yes." I said, "Why?" He said, "Because Butters is a licensee of ours, and he has no right to give the information, and it may interfere with our business." Thereupon I answered, "This article is the property of the 'Mining and Scientific Press'. It is in my drawer here, and no man alive has a right to come to me and tell me not to publish it—not even Mr. Butters. As a matter of courtesy to Mr. Butters, if he asked me not to publish it and gave a valid reason, I should probably acquiesce, as a matter of courtesy, but I have worked on this thing as much as he has, and it is the property of the 'Mining and Scientific Press'." Then I added, in a not unpleasant way, "You have no more right to butt into this than a man in the street. This is going to lead to a great deal of unpleasantness if you press the matter." I think I volunteered to give him the text of the article. At all events, I did give it to him, and I said, "You may take it with you; there is no great hurry about the publication of it," and I think he asked if he could send it to Dr. Gregory—I know he did send it to Dr. Gregory, because he told me so, and then again I told him that I hoped he would not insist on objecting, because I did not want to have a row with him personally. Mr. Frank H. Probert, Professor of Mining in the University of California, was present at the conversation.

In due course—it may have been ten days later—Mr. Nutter notified me by telephone that he had heard from Dr. Gregory, and that Dr. Gregory was not unwilling to have the article published, but that he himself was still unwilling to give his consent. Whereupon I told him I would come down to his office—if I recall correctly, my office was in course of repair, whitewashing or something —so I went to his office. He repeated to me what he had said over the telephone, and I said to him, "What is it that you object to?" "Well," he said, "for instance, what Butters says about treatment of the concentrate by chloridizing-roasting and leaching with cyanide. I am thinking of taking out a combination patent for that myself." "Well," I exclaimed, "Good Lord! That is a thing that any metallurgist would try. It is a thing I tried in 1892." I thought it a most extraordinary objection that the article should be withheld because a most obvious suggestion made by Mr. Butters was one that Mr. Nutter himself proposed to patent, and thereby prevent others from using; nothing new, but simply an idea that had been used at least 28 years before—had been used by myself in Arizona, 28 years ago. Again I asked him not to persist in his course, and urged him to refer the matter again to Dr. Gregory; or it may be that he agreed, without my urging, that he would submit it again to Dr. Gregory. He did submit it again to Dr. Gregory, and a few days later I received a telephone message from Mr. Nutter releasing the article for publication. I said, "Any changes?" He said, "No, it is not worth while," or something of the kind, and the article was published in our issue of August 21, 1915.

Q. Have you had any other experience of a like character?

A. No, because no attempt has ever been made against me since then to curb my proper function as an editor.

Q. What would you say as to the importance of flotation in metallurgy?

A. Well, I heard the question asked this morning, and—

Q. What do you have to say?

A. (continued)—and I at once framed an answer in my own mind, as I heard it asked then: Flotation is one of the most remarkable methods of ore reduction that has been devised by man; but, of course, this does not apply to the one method, but to the many different methods of doing it.

Q. What would you say as to the need of free exchange of information in the development of flotation?

A. Absolutely vital to the welfare of the industry.

Q. Why?

A. Because the progress of individuals is only made

by learning from the efforts of others. No one man ever applied a process successfully on his own experience.

Q. Are you acquainted—I think you said you were acquainted with the license agreement of the Minerals Separation North American Corporation?

A. Yes.

Q. You are acquainted with Clause Nine, which I have shown you?

A. Yes.

Q. The last sentence of which reads: "The licensee shall not, without obtaining the consent of the licensor, communicate any details connected with the work of any of said inventions, modifications, conditions, or improvements to any third party." What would you say the effect of that has been upon the advancement of flotation?

MR. COOK: I object to that as problematic and speculative.

COMMISSIONER THOMPSON: I think that question is too general.

MR. COOK: Indefinite.

COMMISSIONER THOMPSON: And indefinite.

THE WITNESS: Mr. Commissioner, may I ask a question?

COMMISSIONER THOMPSON: You may.

THE WITNESS: In order to get at the whole truth—I am a witness—I think this is the first time I have ever been a witness—am I not to give information that is not asked me in questions? It seems to me in order to get the whole truth—counsel is endeavoring to elicit the truth, but his inquiries do not always throw the light—is it not within my province to tell it?

COMMISSIONER THOMPSON: You are supposed to be interrogated by counsel, and he will take charge of that part of the case.

THE WITNESS: All right.

BY MR. HAWKINS:

Q. From your experience, Mr. Rickard, and your knowledge of flotation, which you have described to us, what would you say as to the advancement of the art in this country?

MR. COOK: I object to the question as indefinite and general.

BY MR. HAWKINS:

Q. Has it been fast or slow?

MR. COOK: I object to that as calling for a conclusion.

COMMISSIONER THOMPSON: I think he may answer.

A. It has been extremely slow, considering the importance of it.

BY MR. HAWKINS:

Q. What has made it slow? Or what has retarded it?

MR. COOK: I object to that.

COMMISSIONER THOMPSON: If he knows.

MR. COOK: And as indefinite and calling for a conclusion of the witness; as incompetent, irrelevant, and immaterial, in no wise binding on these respondents, nor the respondents represented. Exception.

A. I think I do know, and I shall be glad to state. The progress of the art in this country has been retarded by the attempt to impose secrecy upon the experiments and the operations of those using the process, by means, of course, of these license agreements and other methods, but more particularly by the effort to tie individual metallurgists to the chariot-wheels of this patent-exploiting agency, by preventing them from giving information such as comes to—

MR. COOK: I move to strike it out.

COMMISSIONER THOMPSON: I think you are going too far when you speak of patent-exploiting agency. You may strike out that phrase.

A. Patent-owning corporations—we will call it Minerals Separation, for short.

MR. COOK: We won't call it Minerals Separation, for short.

BY MR. HAWKINS:

Q. What corporation do you refer to?

A. I believe I am testifying, sir; to the Minerals Separation, for short.

Q. When you say Minerals Separation, what corporation do you have reference to?

A. I mean the whole caboodle.

Q. You mean the Minerals Separation Companies or the Minerals Separation North American Corporation?

A. Both the one in London and the one in New York, as far as I know, are marked by the effort to bind technical men to secrecy, which is a matter that has greatly hindered the—

MR. COOK: Is there any question on the record? May I ask the stenographer to read the last question?

COMMISSIONER THOMPSON: The question is, what has retarded flotation?

MR. HAWKINS: Yes, he said that the advancement of the art had been held back, and I asked him what had retarded it, and he said he knew, and the objection of counsel came then. He said he knew, and he started to tell what had retarded the advancement of the art when the objection came, and as I understand it he had referred to the name of the corporation indirectly.

MR. COOK: Isn't that all speculative, whether there is any retardation or not?

MR. HAWKINS: No, here is a man—

THE WITNESS: As an example of the methods by which the art has been retarded, I cite a case that came to my notice, of E. M. Hamilton, who gave me a copy of an agreement or contract whereby a metallurgist in the employ of a licensee is estopped from giving any information to anybody, and he is bound to disclose anything he discovers in the course of his work to Minerals Separation. I published such an agreement in the 'Mining and Scientific Press', an agreement which was enforced and binding on Mr. Hamilton.

Q. Will you look into your files this evening or in the morning and find the publication of this contract?

A. Certainly, I will. So I looked at this agreement and it seemed to me to be extremely one-sided, and I advised Mr. Hamilton to take legal advice. I asked him if he would let me have a copy of the agreement and said I would submit it to a lawyer, because I was curious my-

self to know whether it was legal or not. I submitted it to a good lawyer, C. Irving Wright, and he advised me—

MR. COOK: I object to that.

COMMISSIONER THOMPSON: That is hearsay evidence, Mr. Rickard, unless you can produce—

A. I can produce the attorney's published statement, which was published in connection with the agreement, in my paper.

COMMISSIONER THOMPSON: You are not permitted to say what he said to you.

THE WITNESS: No, but he gave me his opinion, and he allowed me to publish it, and I published it, together with the copy of the agreement in Mr. Hamilton's name, and I told Mr. Hamilton, as I told other engineers, that I thought it was an iniquitous thing, and that it was peculiarly objectionable when it was entered into by an honorable man, because it tied him for the rest of his natural life—practically tied his hands as a metallurgist, because it made it extremely difficult for him to accept employment or a retainer from any other clients; while, on the other hand, Minerals Separation did not give the party to the contract anything in exchange for binding him.

MR. COOK: I object upon all grounds to what Mr. Rickard said to Mr. Hamilton, and I move to strike it out.

COMMISSIONER THOMPSON: Now, this is what he said in the discussion in his paper, I understand.

MR. HAWKINS: His opinion of the contract, what he thought was the iniquity of it, because it lacked consideration.

THE WITNESS: Certainly.

BY MR. HAWKINS:

Q. Have you any other instances of a similar character?

A. Yes, but not instances that I can recall sufficiently clearly to be worth relating here. I have had letters from time to time from people telling of their troubles. Mr. Jackson Pearce, for instance, told me some of his troubles.

Q. He told us that on the stand.

MR. COOK: I have here the article: February 5th, 1916. I think that is the publication.

THE WITNESS: Thank you. That is it.

BY MR. HAWKINS:

Q. Mr. Rickard, I have here the copy of your magazine under date of February 5, 1916, and on page 193 a copy of the agreement that you have just referred to in your testimony, which is the agreement with Mr. Hamilton, I understood you to say. As you have published here in your magazine, it was made with John Doe, and it appears that John Doe is a member of the staff of the Minerals Separation Syndicate, and that this form of contract here is one that was made with the members of their metallurgical staff. What do you know as to whether Mr. Hamilton, at the time he had this contract, or made it, at the time you refer to in your testimony, was or was not, a member of their metallurgical staff?

MR. COOK: Isn't Mr. Hamilton the best witness to testify to that?

MR. HAWKINS: I am asking him whether he knows.

Q. Have you any personal knowledge on the question?

A. No. It seems to be a question as to whether this contract was forced upon him as an employee of Minerals Separation or as an employee of Charles Butters. He gave me the information that it was a contract which had been forced upon him, and whether it was forced against him as one or the other, it was an objectionable contract on every account.

CROSS-EXAMINATION

BY MR. COOK:

Q. Mr. Rickard, I suppose this 'Mining and Scientific Press', of which you are editor, is sold, is it, by you to the public?

A. It is not given away.

Q. And the company that runs it, runs it for profit?

A. *Vous avez raison, vous êtes juste.*

Q. *Merci, Monsieur.*

REPORTER: I didn't get that.

THE WITNESS: You can put down, "A glimpse of the obvious," as Huxley said.

Q. Is Mr. Parke Channing a stockholder of your company?

A. Yes, sir, he holds $5000 out of $300,000; he is one out of 22 shareholders, and he is the largest shareholder outside myself; that is to say, no other shareholder has more than $5000, and I personally own three-fourths.

Q. Do you know whether Mr. Channing has any affiliations as an engineer with the Utah Copper Company?

A. No, I don't know.

Q. You have no knowledge on that subject?

A. I would be surprised to find out that he had.

Q. Would you be surprised to find out that he was the consulting engineer of the Miami Copper Company?

A. I believe he is vice-president of the Miami Copper Company.

Q. Do you know Mr. Argall?

A. I do, indeed.

Q. Is he a stockholder of your company?

A. He owns $5000, par value, which he has owned for 15 years.

Q. Do you know whether or not—

A. And the same applies to Mr. Channing; they both hold that small holding and have for 15 years.

Q. Do you know whether or not he has any control of the operations of the Argo mill in Colorado, at Idaho Springs?

A. No, I do not. That is news to me.

Q. And do you know whether or not he had anything to do with the installation of the flotation process at the Ozark mine in New Mexico?

A. Yes, I believe he had, because he told me so.

Q. You know, do you, that since 1911 to date, the Minerals Separation, Ltd., the Minerals Separation American Syndicate of 1913, Ltd., and Minerals Separation North American Corporation, are engaged in litigation in the United States courts with respect to their various matters?

A. Certainly.

Q. And you know that the litigation is being vigorously defended?

A. Defended as against them?

Q. Yes.

A. Not as vigorously as it ought to be, it seems to me.

Q. Not as vigorously as it ought to be?

A. No, not as effectively as it ought to be.

Q. But it is being defended vigorously and effectively?

A. I presume so.

Q. And that has been the situation constantly since 1911 in this country with reference to patents of Minerals Separation?

A. Yes.

Q. The case has gone up and down in various courts and been commented upon by you from time to time?

A. Yes.

Q. You say you were in London in 1909?

A. Yes.

Q. You are a native Englishman?

A. I am a native of Italy, but a man is not a horse because he is born in a stable. My father was a Cornishman.

Q. But a man may be always a gentleman?

A. Yes, sir, even under extremely difficult conditions.

Q. When did you become a naturalized citizen?

A. I am not yet naturalized: I have declared my intention.

Q. You are not an Englishman?

A. No, sir, I am not; I am an American.

Q. Do you recall a publication of yours in 'The Mining Magazine' when you were editor?

A. No, sir: I might recall one, but probably you are going to refer to a particular one.

Q. Do you know the one I want to refer to?

A. No, I have not the slightest idea.

Q. As editor, do you accept responsibility for publications in your magazine, of which you are editor?

A. I do.

Q. You were the editor of 'The Mining Magazine' in May 1911.

A. Yes.

Q. I show you an article on the subject of flotation processes, and ask you whether that was not published by 'The Mining Magazine' under your editorship?

A. I have no doubt that that is a correct facsimile.

MR. COOK: I will ask to have it marked in evidence.

Q. Now, in your 'Mining and Scientific Press', when you came to San Francisco, you published a great many articles with reference to Minerals Separation, did you not, Mr. Rickard?

A. I did, yes.

Q. And Mr. Nutter wrote you a letter, did he not, calling to your attention this article that I have just read, and you declined to publish it later. Do you recall that?

A. No, I do not, but if he says so, I accept it. Yes, I do; I do recall his asking me, and didn't I give a reason?

Q. Yes, I am going to get the correspondence. Did you not receive under date of October 11, 1917, from Mr. Edward H. Nutter, chief engineer of the Minerals Separation North American Corporation, a letter of which I am handing you a copy, to which was attached a copy of the article that I just read in evidence?

A. Yes, I think that is so.

Q. That is the copy?

A. Yes.

Q. I show you what purports to be a copy of your reply, and ask you whether that is not a correct copy?

A. May I read it?

Q. Yes.

A. "Yours of the 1st inst. came duly to hand, and I have read it with interest. The editorial in 'The Mining Magazine' that you were kind enough to copy was not written by me, but by Mr. Walker. I can see no point in publishing it in our paper, but I shall always be glad to publish anything that you care to write." May I have my reply to Mr. Nutter in the record?

MR. COOK: I am going to get it all in.

THE WITNESS: Because, you see, the suggestion is made that I wrote that editorial, and I didn't write it. Mr. Walker was my associate and assistant.

Q. You were editor of the paper that published it?

A. I was.

Q. And as you have stated in answer, you accept responsibility for everything published in your paper of which you are editor?

A. I simply wish to establish my personal consistency, that I did not write the editorial and could not have written it. At that time I took very little interest in the flotation quarrel, and I deputed that matter, which had mainly to deal with the litigation then going on in London, to Mr. Walker, who had been interested in it for some time previous to my coming to London.

Q. You received the letter from Mr. Nutter in reply to that, did you not, of which this is a copy (handing witness a letter)?

A. Well, that is merely a piece of maladroit humor.

MR. COOK: Well, we have had so much adroit humor from you—

MR. PORTER: I object to this. I don't think counsel has to indulge in such remarks as that.

COMMISSIONER THOMPSON: The witness did not answer the question.

THE WITNESS: Mr. Commissioner, I submit that the correspondence could not be understood by anybody reading the record, and they appreciate the fact.

COMMISSIONER THOMPSON: He asked you a question, and you have not responded to it, that was the point. You wrote the letter?

BY MR. COOK:

Q. You wrote the letter?

A. You asked me whether I received it.

MR. COOK: The only point is, we offered this letter to Mr. Rickard for publication, and he declined to publish it for the reason he stated, and there was some personal correspondence between him and Mr. Nutter on the sub-

ject, and the maladroit humor, or otherwise, is not important in the case.

Q. Mr. Rickard, suppose you went to an inventor of a process and asked him to teach you and instruct you in the process, and its variations, and give you access to his plant, his laboratory, and acquaint you with the details of his business, do you think it important for that inventor to bind you to secrecy as to what you learned?

A. I would not go to him under those conditions.

Q. Please answer my question.

A. It is so suppositious.

Q. You would not go to him under such circumstances, but if you went to him under those circumstances?

A. If I went to him under those circumstances, I would refuse to sign any contract without a time limit. I probably would refuse to sign any contract of the kind to which you are now alluding.

Q. Well, you recognize the right, don't you, of the inventor to say, "Well, if you come to me and ask for instructions and ask for the secrets of my business, and all of the details of it"—to decline to give you that information unless you—

A. Well, he has a perfect right to decline to do anything.

Q. There is no obligation, is there, on the part of an inventor of a patented process to instruct another in the secrets or the details of it?

A. Yes, sir, but you have entirely overlooked the fact that I have denied from the beginning the invention by Minerals Separation. I don't believe that Minerals Separation invented the process of froth-agitation—I believe they only contributed to it.

Q. Mr. Rickard, irrespective of your own individual thought or view of the subject—

A. I can't disregard anything without respect to my own individual thought, sir. Why do you ask me such a foolish question?

Q. Well, it is a habit of mine not to be able to ask you any other kind of a question, I regret that. Unfortunately, I have not had the literary experience you have had.

THE WITNESS: It would have been useful.

MR. COOK: Yes, sir.

COMMISSIONER THOMPSON: Until counsel and the witness can get on a better basis, don't let us incumber the record.

MR. COOK: I think the Commissioner will bear with me in saying that I am trying to get along with the witness.

BY MR. COOK:

Q. Are the views that you have expressed today, as well as those that you have expressed from time to time in your publications, based upon the statement just given that you do not believe that they are the inventors?

A. I believe they were not the sole inventors of the froth-agitation process, but very important contributors to the development of the process.

Q. And I say the views you have expressed today, and from time to time—

A. Yes, sir.

Q. —are based upon the opinion you have given me?

A. Upon the belief.

THE WITNESS: Can I suggest a question, Mr. Commissioner, a question to the counsel that will elucidate—I have taken an oath to tell the truth and the whole truth—

COMMISSIONER THOMPSON: It is up to your counsel.

MR. HAWKINS: You mean me?

THE WITNESS: Yes, sir.

[The witness left the stand and said to Mr. Hawkins: "The question asked by counsel over there insinuates a sinister imputation; I want you to ask me when and how Mr. Argall and Mr. Channing became shareholders in the 'Mining and Scientific Press'." He then returned to the witness-chair].

MR. COOK: Mr. Rickard, I asked you as to the connection of Mr. Channing and Mr. Argall with your paper, and you told me of their interest. I did not mean to insinuate anything, but I simply wanted to ascertain whether they had a large or small interest in it. I had no thought of insinuation, Mr. Rickard, on the subject, and I think in fairness to you I ought to say and assure you that there is no insinuation whatever.

THE WITNESS: We will put the matter beyond any doubt.

BY MR. HAWKINS:

Q. Is there any further explanation you wish to make with regard to the articles, or in regard to the subject of Mr. Argall or Mr. Channing?

A. Mr. Argall and I are personal friends. I knew him as a small boy. He was associated with my father. Parke Channing has been a personal friend of mine for nearly 30 years. Both of them were friends of mine long before the flotation issue appeared upon the horizon, and their holdings in the paper are very small. The only reason why there are any shareholders besides myself is because I wished to have the pleasant responsibility of having some small holdings by a number of representative engineers.

[Editorial comment on these proceedings will be found elsewhere in this issue. On page 279 we reproduce the editorial in 'The Mining Magazine' concerning which Mr. Nutter wrote.]

ELECTROLYTIC-ZINC works are now manufacturing spelter at Hobart in connection with the hydro-electric power scheme financed by the Tasmanian government. In addition to spelter, zinc sheets are being rolled, and it is proposed to extend the manufacture to the following: Lithopone blocks for marine boilers; zinc-shavings for the gold industry; zinc-dust for sherardizing metallic aluminum; ferro alloys; zinc alloys; zinc chloride; zinc sulphate; caustic soda; bleaching-powder; other chlorine products; and calcium carbide. The outlay of these works is estimated at £1,500,000, and the plant, which is now producing 70 tons of spelter per week, is being extended to produce 100 tons per day. In 1918 these works produced from New South Wales ore 3822 tons of spelter, at £152,880, and in 1919, 3668 tons, at £160,660.

Curves for Ore-Valuation

By K. K. HOOD

The estimating of tonnage in the ground and arriving at a value of that tonnage is far from an exact science. There is, however, often a certain amount of mathematical computation in which the same assumptions have to be made. These become burdensome because of their repeated application. In such cases charts or curves constructed from the desired data may be of assistance, and it was with this idea in view that the two curves shown herewith (Fig. 1 and 2) were constructed.

Fig. 1 shows a graph to be used in the computation of valuation of ore similar to that found in the Wisconsin zinc districts, where the minerals in the ore are a combination of zinc and iron sulphides in a proportion within the limits of the curve, and where the factors and resultants considered are (1) metallic zinc in the ore as indicated by sampling and assaying, (2) metallic iron in the ore, (3) grade of recoverable ore, (4) grade of concentrate produced, (5) the ratio of concentration, (6) cost of mining and milling per ton of ore, and (7) cost per ton of crude concentrate produced. Having given any two or more of these factors, the remaining factors may be determined by inspection from the graph. In constructing the curve it was assumed that 70% of the zinc and 40% of the iron, as shown by assay, would be recovered, and that the resulting concentrate would contain 10% of gangue.

As an example, assume a certain block of ore has been sampled by churn-drilling or other means and that the average assay shows 6% metallic zinc and 5% metallic iron. Without the curve shown in Fig. 1, the results may be arrived at as follows:

$70\% \times 6 = 4.2\%$ Recoverable zinc.
$4.2\% \times 1.5 = 6.30\%$ Recoverable blende.
$40\% \times 5 = 2.0\%$ Recoverable iron.
$2\% \times 2.14 = 4.28\%$ Recoverable pyrite.
$6.30\% + 4.28\% \div (100\% - 10\%) = 11.75\%$ Grade of recoverable ore.
$4.2\% \times 100 \div 11.75 = 35.7$ Grade of zinc concentrate produced.
$100 \div 11.75 = 8.5 : 1$ Ratio of concentration.

The curve shown in Fig. 1, however, represents these derivations graphically for any combination of zinc and iron within the limits of the graph, thus: At the intersection of the 6% 'Zinc in Ore' and 5% 'Iron in Ore' lines read 11.75%, grade of ore; 35.7% grade of the concentrate. Then trace a line parallel to the 'Grade of Ore' lines and through the point of intersection just de-

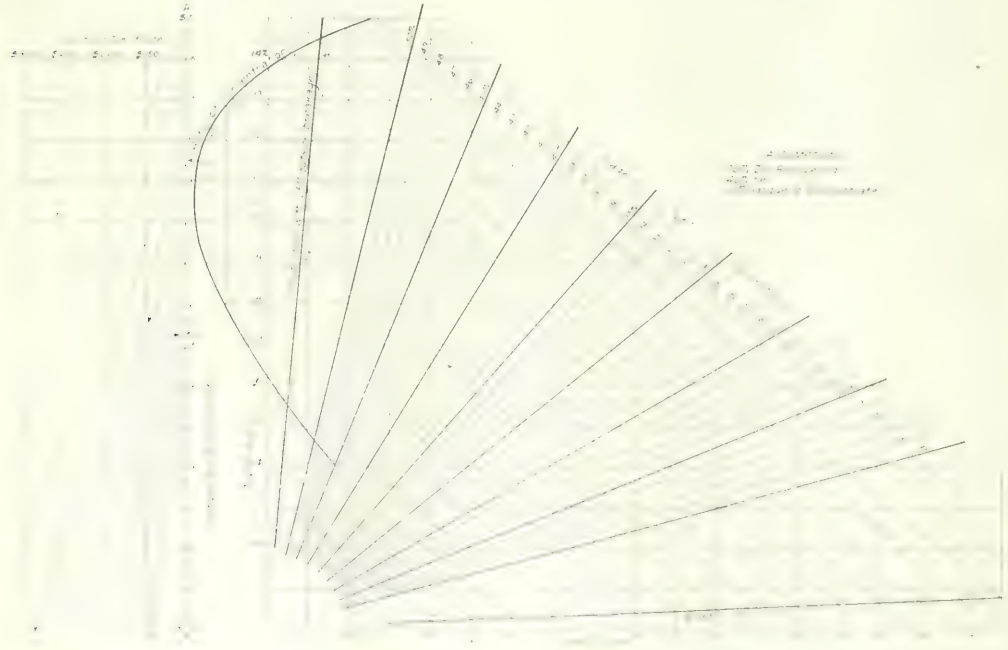


FIG. 1

termined, and at the intersection of this line with the 'Ratio of Concentration' line read 8.5 : 1, ratio of concentration. See dashed line. The cost per ton of concentrate may also be determined from the graph by finding the intersection between a line drawn from a point on the *A-A* axis, whose value corresponds to the ratio of concentration, and is equi-distant from the diverging lines from this axis, and the line corresponding to the desired 'Cost per ton of Ore'. From this point trace to the right until the *A-A* axis is cut and read, 'Cost per ton of Concentrate'. Using the above example and assuming a mining and milling cost of $1.50 per ton, read on the graph $12.75, cost per ton of concentrate. See dashed line. With a little practice the dashed lines as shown on the figure can be traced mentally and the above results determined at a glance. In determining the 'Cost per ton of Concentrate', it will be noted that there may be assumed ten small spaces on the *A-A* axis between every large division and ten small divisions along the line *B-B*, between each of the diverging lines drawn from the *A-A* axis; so that a line may be drawn equi-distant from any two of these diverging lines by connecting points on the *A-A* axis and the *B-B* line located the same number of small divisions from one of the two diverging lines. Where this line cuts the desired 'Cost per ton of Ore' line, read cost per ton of concentrate directly opposite on the *A-A* axis.

In a great many cases experience has shown that in the actual mining of a block of ore considerable more rock is mined than estimated, and that the grade of the ore is less than that figured. This is due perhaps to the fact that ground is broken above the roof as figured, and that mining is carried on outside the assumed areas owing to the lack of a definite line between what is pay-

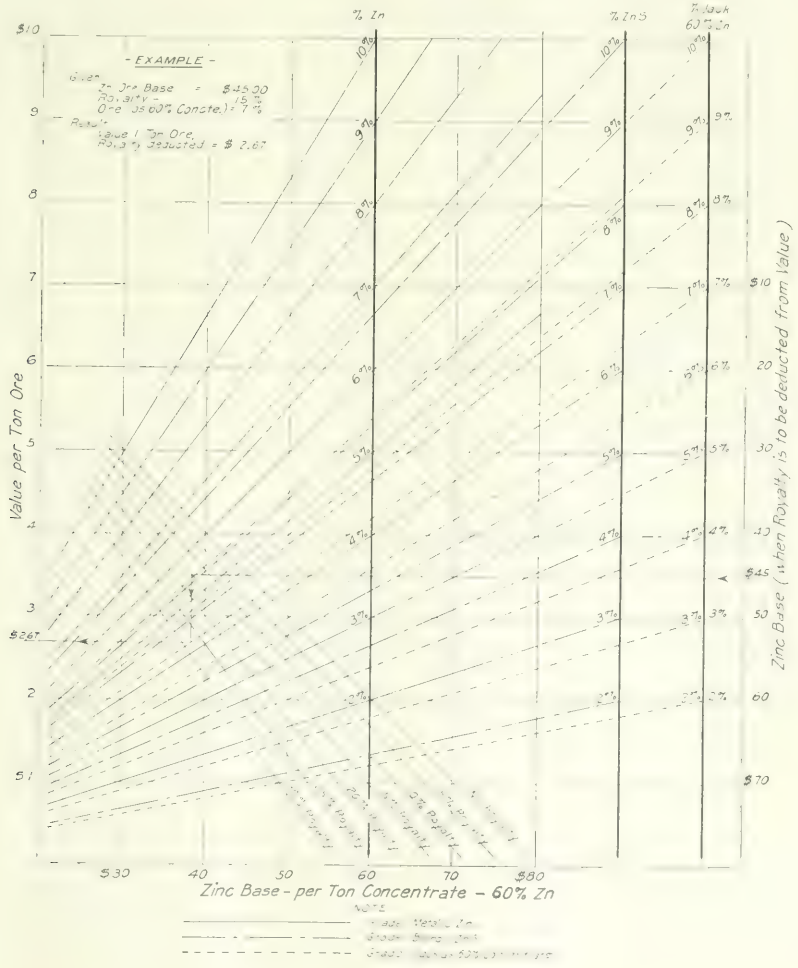


FIG. 2

ore and what is not, and the necessity of mining barren ground to expedite the mining of indicated ore. The consideration of the character of the orebody and one's experience is about the only method that can be used to determine the value or amount of this mining of ground outside the assumed ore-bearing areas. In the construction of the curve shown, a line was added whereby if it was assumed that an amount equal to 25% of the ore estimated within an area would be mined, in addition to that estimated, and that this 25% outside breakage would contain no metal, the resulting grade of ore of the whole could be read from the graph. See line marked 'Grade of ore with 25% outside breakage'. Using the above example with 25% outside breakage, the grade of the ore as shown by the curve is 9.4%, instead of 11.75%, with no outside breakage. The grade of the concentrates will of course not change, but the ratio of concentration will be increased. The effect of using an outside-breakage factor is practically the same as using a sampling-error, as far as the grade of recoverable ore is concerned.

Fig. 2 represents a series of curves applicable to an ore similar to that found in the Joplin-Oklahoma zinc district, using the following factors or variables: (1) Value per ton of crude ore; (2) recoverable grade of ore expressed in percentage as metallic zinc, zinc-blende, or as 60%-zinc concentrate; (3) market-price of 60%-zinc concentrate; and (4) percentage of royalty to be paid on the selling price of the zinc concentrate. Having given any two of the above-mentioned factors, the remaining factors may be determined by inspection. For example, assume that a certain mine is required to pay 15% royalty on all the zinc concentrate sold, that the ore runs 7% recoverable 'jack', and that the cost of mining and milling per ton of ore is $2.67; the graph shows the minimum market-price of the zinc concentrate on which operation can be conducted without loss to be $45. This figure is arrived at thus: From a point corresponding to $2.67 on the 'Value per ton Ore' axis trace to the right until the 7%-jack line is intersected; thence at right angles until the 15%-royalty line is cut; thence to the right again until the 'Zinc Base when Royalty is to be deducted' is intersected. This point corresponds to $45.

The graph also shows the equivalents in terms of zinc-blende, and 60%-zinc concentrate for values of metallic zinc within the limits of the curve. For example, the curve shows that 6% metallic zinc is equivalent to 9% blende, or 10% jack as 60% concentrate, or that 7% jack is equal to 6.3% blende, or 4.2% metallic zinc.

A REPORT ON GRAPHITE, just published by the Canadian Department of Mines, points out that Canada possesses deposits of flake graphite superior in richness and quality of flake to any on the American continent. What is probably the largest and richest deposit of flake graphite known in the world occurs in Ontario and is worked by the Black Diamond Graphite Co. Difficulties of concentrating and refining the graphite, however, have long hampered operators. Recently, these difficulties have been overcome by the employment of the oil-flotation system of ore concentration, which yields far better results than were obtainable by the old methods, both in the richness in carbon of the concentrate made and in the amount of graphite recovered from the ore treated. Several Canadian mills have now been equipped with the flotation process and are producing refined graphite equal, if not superior to, the best graphite on the market.

Production of Zinc

Figures compiled by C. E. Siebenthal, of the U. S. Geological Survey, from reports submitted by all zinc-smelters that operated during the first six months of 1920, show that the production of zinc from domestic ore in that period was 251,065 short tons, and from foreign ore 7043 tons, a total of 258,108 tons, as compared with 210,241 tons in the last half of 1919 and 255,502 tons in the first half. The stock of zinc held at smelters June 30 was 29,892 tons, having decreased from 36,793 tons at the end of 1919, and 59,651 tons at the middle of that year.

From the foregoing figures, and from the statistics of imports and exports, as recorded by the Bureau of Commerce, it is calculated that the apparent consumption for the period was 175,268 tons, as compared with 164,463 tons in the last half of 1919 and 159,501 tons in the first half. In addition to the zinc produced from ore, 12,474 tons was re-distilled from zinc-ashes, skimmings, and drosses. Much of this zinc was of a grade above prime Western, and the total, added to the primary output, gives 270,582 tons consisting of 41,177 tons of 'high-grade', 17,310 tons of 'intermediate', 37,917 tons of 'select and brass special', and 174,178 tons of 'prime Western'. Electrolytic zinc amounted to 24,035 tons, as compared with 3845 tons in the last half of 1919, and with 23,211 tons in the first half. The total number of retorts at plants at which there were some operations during the first half of 1920 is 157,456, as compared with 157,004 at the end of 1919 and with a maximum total of 224,778 on June 30, 1917. The number of retorts in operation on June 30, 1920, was 95,000 as compared with 107,500 at the end of 1919 and 82,000 on June 30, 1919. English zinc smelting is greatly curtailed by high operating charges, and smelters on the Continent are handicapped by heavy fuel costs. Belgium alone is steadily increasing operations, the output of zinc in the first half of 1920 being apparently about 40,000 tons. At the rate of increase which has been maintained since the beginning of the year, the output at the end of the year should be in excess of 14,000 tons per month, or at the rate of about 170,000 tons per year, approximately 80% of the pre-war capacity.

The price of prime Western zinc at St. Louis at the beginning of the year was 9.05c. per pound, but it rose to 9.37½c. by January 9 and then by a long decline, broken by several slight recoveries, reached 7.35c. on June 18, rising to 7.6c. at the close of the half-year. The average for the period was 8.36c. per pound, as compared with 7c. for the year 1919.

The Flue Type of Cottrell Treater

By A. B. YOUNG

*Introduction. The object of this paper is to describe a Cottrell treater that was placed in operation in April 1919 at the Tooele plant of the International Smelting Co., for the purpose of recovering solids in the smoke from the McDougall roasting-furnaces. The treater is simply a flue containing rows of vertical plates, forming the grounded electrode, alternating with rows of small horizontal pipes, forming the negative electrode. Means is provided underneath for taking away the dust that collects. This construction has certain advantages over the more cumbersome types, both the vertical-tube and the vertical-box, particularly in avoiding heavy supporting columns and massive foundations. There are no right-angle turns to interfere with distribution of the smoke; consequently there is greater efficiency, or, in other words, a greater volume of smoke per minute can be effectively treated. Another advantage of the horizontal construction over the vertical is that the principle of the selective precipitation of the various components of the fume as it passes along the electric field may be utilized. Since the treater has been placed in operation, the results have been satisfactory, in many ways, particularly in regard to the volume of gas that may be treated.

Construction. In the original design the flues from the roasters delivered their smoke to a large brick dust-chamber that discharged into another flue connecting with the stack, as shown in Fig. 1. The treater is so situated that the smoke is taken by it directly from the chamber and discharged again into the flue. The complete plant will comprise two units, only one of which has been erected at present.

The treater is essentially a flue 10 ft. high, 12 ft. wide, and 61 ft. long. Suspended inside, vertically, and running lengthwise, are four banks of No. 20 corrugated-iron plates; each bank is 10 ft. long, making an effective length of 40 ft. The spacing from centre to centre of the rows of plates is $9\frac{1}{8}$ in., giving 16 rows of plates per bank. Mid-way between the rows is a row of horizontal $\frac{1}{4}$-in. pipes, running longitudinally; the vertical spacing between them is 6 in. The plates form the grounded, and the pipes the negative, electrodes. Allowing for the thickness of the plates and the area of the pipe-sections, the treater has an effective cross-section of 113.5 square feet.

Steel hoppers that discharge into a screw-conveyor catch the dust underneath; the conveyor delivers into a small bin built in a shaft beneath the treater. This bin may be emptied into cars that are used to charge the reverberatory furnaces and run upon tracks in a tunnel under the large dust-chamber.

The unit is divided into two electrical sections constructed in a straight line and operating in tandem. Each section contains two 10-ft. banks of plates, or an effective length of 20 ft. The pipe electrodes are 26 ft. long and extend through both banks of plates. These pipes are supported by three grids, one on each end and one in the middle between the two banks of plates. The intermediate supporting grid is necessary to keep the sag of the pipes within allowable limits. The grid is built up with $1\frac{1}{4}$-in. pipes that have been bored to allow the passage of the $\frac{1}{4}$-in. pipes, and is suspended from a beam carried on post-insulators. A box encloses the insulators and the beam on top of the treater, as shown in Fig. 2. The feed-wire is brought into this box through an insulator-bushing. Each insulator is completely enclosed in a small compartment, which protects it from the stream of gas.

The channel-iron beam that rests upon the insulators passes through ring-gaps in the inside walls of these insulator compartments. The ring-gap consists of a ring, made of a $1\frac{1}{4}$-in. pipe with the ends welded together and welded to a round opening in the wall, and a short length of 10-in. pipe slipped over the beam, making a 2-in. gap. The opening inside the 10-in. pipe is filled with cement.

Each row of corrugated-iron sheets, forming the plates, is suspended, with the corrugations vertical, from the top by means of two angle-irons back to back, making a slot into which the sheets are inserted and secured with bolts. Much the same arrangement is used at the bottom as a guide only. The sheets are not bolted to the bottom angles, nor are they fastened to one another. They must be carefully inspected before being put in the treater, only those free from warp being used. The top of the treater is made of steel plate; and the side walls and the insulator house are made of $\frac{3}{8}$-in. transite board mounted on a steel framework.

Knocking devices are provided for shaking the dust from the plates and pipes. For the former, there are four knockers, one in each space between the insulator-boxes. The knocker is composed of a shaft, running transversely across the top of the treater, to which hammers are attached, one for each row of plates. The shaft is partly rotated by a handle attached to it, and the hammers strike the angles that support the plates, first on one side of the shaft and then on the other. The two pipe-knockers are similar in design and are arranged to hit the under side of the middle grid of each electrical section. Small doors in the sides opposite the grids enable a man to enter the treater to make necessary repairs.

The treater is supplied with a sliding damper at the intake by means of which all smoke can be shut off, and with a butterfly damper at the outlet. There is a butterfly damper also in the section of the old louvers, one

*A paper to be read at the Lake Superior meeting of the A. I. M. & M. E. in August 1920.

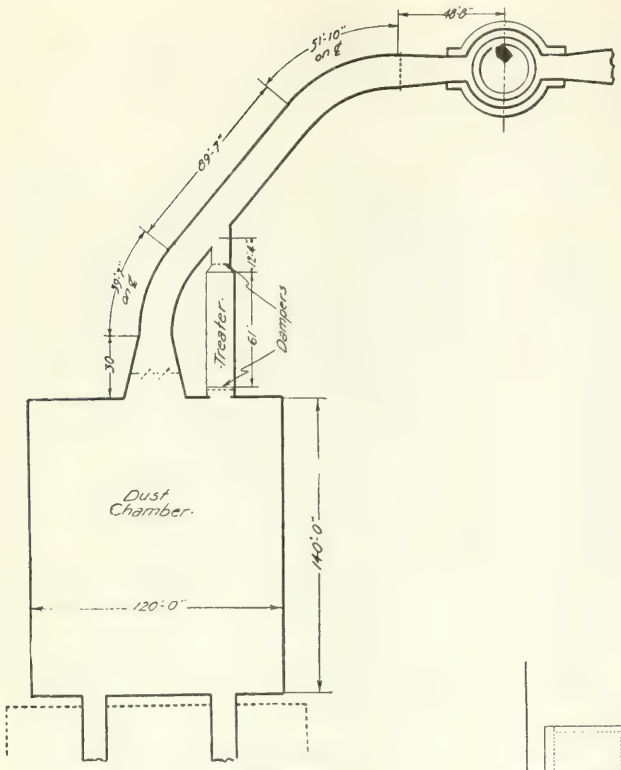


FIG. 1. PLAN OF FLUE SYSTEM

having vertical and other horizontal axes. At the outlet there is one set with horizontal axes. The purpose of these was to regulate distribution, but so far they have not been used.

Nine hoppers underneath the treater collect the dust. The ends, as well as the sides, of these hoppers come up to the floor-line and each is provided with a vertical baffle, which extends through the treater from the floor-line nearly to the bottom of the hopper to prevent gas from leaking through.

ELECTRICAL EQUIPMENT. The electrical equipment for each section is as follows: one 25-kva., 100,000—87,000—75,000—62,500—50,000 to 220-volt transformers; one 31-in. disc-type mechanical rectifier; one 3-hp., 1800-r.p.m., 200-volt, three-phase, 60-cycle, synchronous motor for driving the rectifier; one 37½-kva., 2200 to 220-volt, single-phase transformer; one 1.25-ohm grid-resister with current-carrying capacity of 100 amp., divided into seven sections; one 2.75-kva., 60-cycle, 220-volt, 22-volt, 125-amp. motor-generator induction regulator; three 7½-kva., 2200 to 220-volt single-phase transformers; one switchboard panel with necessary meters, etc. In supplying power, the procedure at this treater follows that of the other Cottrell installations of the Tooele smelter, that is, to step down one phase from the smelter main power-line, so that it can be handled on the switchboard. The current is then put directly on the treater-transformer, using a synchronous motor to operate the rectifier. No motor-generator sets are used. The voltage is regulated by means of a grid-resistor, the final adjustment being made by means of an induction regulator, thereby gaining much closer control of the voltage than can be obtained from use of the grids only.

OPERATION. In the operation of the treater, the pipes and plates are cleaned periodically. During the few minutes required for this work, the dampers at each end of the treater are closed and the gases by-passed. Accumulations of the collected

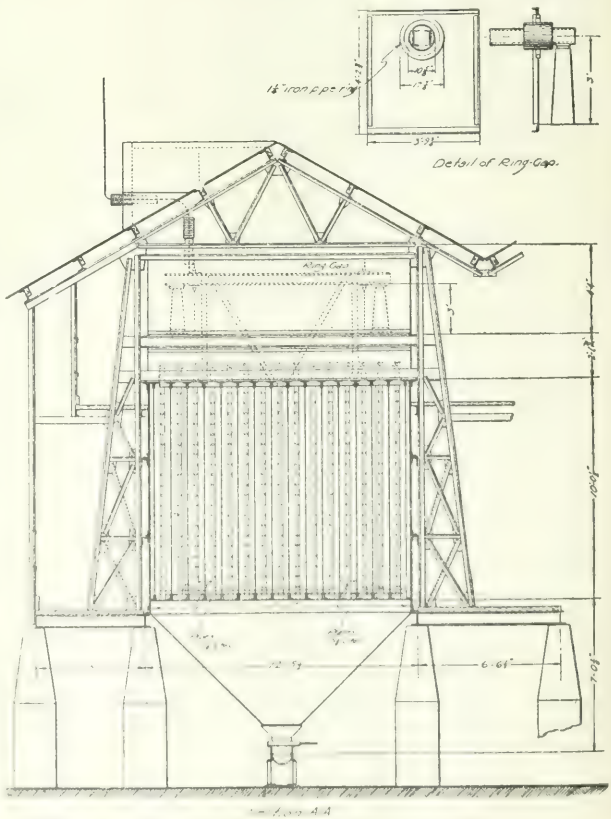


FIG. 2. SECTION OF COTTRELL TREATER

dust not readily removed by the knockers have not been found to interfere with electrical conditions, nor with the efficiency of the treater, probably because of its acid content and high electrical conductivity. After some time, this dust forms a thin permanent scale upon both plates and pipes. This is almost impossible to remove, and might, in appearance, be compared to boiler-scale.

A number of aspiration tests have been made to determine the recovery obtained by the treater for actual gas-velocities varying from 15 to 22 ft. per second. Typical recoveries, which vary little within this range of velocity, are shown in the following table:

Metal	Recovered %
Copper	98.2
Lead	81.2
Silver	96.5
Gold	96.4
Total recovery	93.97

The velocity through the treater, under actual conditions of temperature and pressure, is 21.45 ft. per second; the volume is 146,004 cu. ft. per minute. The temperature at the outlet averages 260°F., and at the inlet, 280° F. The uniformity of distribution is probably responsible, in large measure, for the efficiency attained with the high velocity, which is approximately equivalent to a breeze at 15 miles per hour. The upper limit of velocity for 40 ft. of plate-electrode has not been determined, but a material drop in recovery has been noted at 31 ft. per second.

It has been mentioned that advantage may be taken of the principle of selective precipitation in this type of Cottrell treater where the composition of the dust or fume is such that the recovery of several products is possible. Table I shows the distribution of the various components of the dust drawn from the successive hoppers underneath. The hoppers are numbered beginning at the intake.

Table I—Analysis of Dust

Hopper No.	Copper %	Lead %	Silver, ounces per ton	Gold, ounces per ton	Insoluble, %	Iron, %	Sulphur, %	Lime, %
1	8.30	3.2	6.84	0.45	19.7	18.7	14.3	2.6
2	8.30	3.7	6.26	0.44	20.6	17.1	14.0	2.6
3	7.60	5.3	6.82	0.38	20.0	17.3	14.0	2.5
4	7.00	6.8	6.96	0.34	19.2	15.3	14.7	2.3
5	6.00	8.2	5.94	0.30	16.8	13.4	14.7	2.1
6	5.15	11.6	5.90	0.27	16.1	12.3	14.0	2.2
7	4.55	13.1	5.36	0.24	13.5	10.2	15.5	1.7
8	3.95	15.5	4.80	0.19	11.4	8.7	15.2	1.5
9	3.80	14.8	4.30	0.19	10.3	8.4	16.2	1.7

The outstanding feature is the constantly decreasing copper content and increasing lead content as the outlet is approached, thereby permitting a portion of dust to be segregated and smelted for its lead. An examination of the figures for iron and insoluble bears out the idea that there is a marked tendency to precipitate the true dust particles near the entrance, and that the more impalpable fume must travel farther through the electric field before being caught.

It is extremely difficult to state accurately the power-input to the treater, other than that it is lower than usual and varies considerably. For normal gas-volumes (125,000 to 150,000 cu. ft. per minute), the input of power will average close to 8.4 kva. for the first electrical section and 5.5 kva. for the second. Approximately 85% of the dust caught is collected by the first and 15% by the second section. Sphere-gap peak-voltages run from 30,000 to 35,000, and occasionally higher; they are usually about 1000 to 1500 volts higher in the second than in the first section.

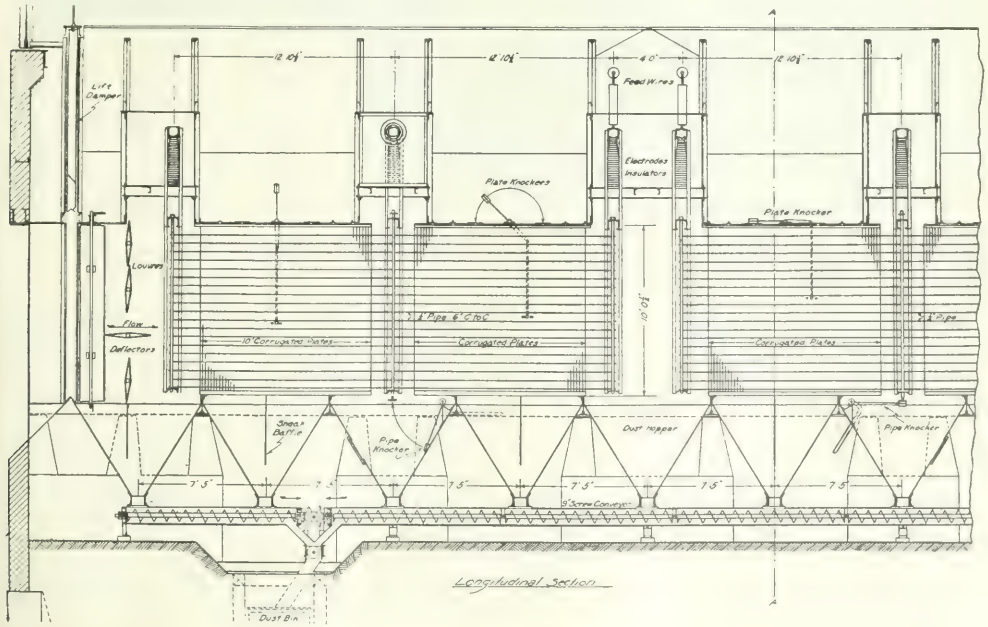


FIG. 3. ANOTHER SECTION OF THE TREATER

In conclusion, it may be said that this form of treater has proved admirably adapted to this particular smoke. Its ability to treat a purely fume product satisfactorily is an unsolved question, no data being available for its performance in this regard. However, when one compares the compact flue-like building, which is efficiently handling 150,000 cu. ft. of gas per minute, with the complex towering structures of the vertical type necessary to treat a like amount, a distinct forward step is apparent.

Credit should be given to O. M. Kuchs, assistant general manager of the International Smelting Co., for the suggestion of the horizontal electrode and the use of pipe for this purpose, thereby making the adaptation of the plate-type treater to a horizontal flue feasible; to R. B. Sumner, mechanical superintendent of the Tooele smelter for its design; and to B. L. Sackett, superintendent of the lead-plant at the Tooele smelter for the experimental work done in its development.

The Paddy Pride Mine

The Paddy Pride Silver Mining Co. owns the Oversight group of five claims, nine miles west of Zabriskie, California, a station on the Tonopah & Tidewater railroad. The claims are in a rugged country consisting of a series of irregular, rough, and jagged limestone hills at the southern end of the Funeral range. The claims are at an altitude of 1500 ft. above Zabriskie. Water is hauled from Shoshone, 16 miles distant, over a good wagon-road, the last mile of which is steep and winding.

The outcrop was found at the top of the ridge and some rich lead-silver ore was shipped from it. The outcrop was then traced along the side of the hill and a 150-ft. tunnel was driven in the vein, cutting it at a depth of 180 ft. At 150 ft. from the portal there is a fold in the vein and a raise was driven, the continuation of the ore being found. Raises and two winzes were sunk in ore. There is a 50-ft. inclined winze 50 ft. from the portal of the tunnel and a 25-ft. vertical winze 110 ft. from the portal. The ore is persistent in these winzes and in a drift from the vertical one there is rich ore.

One carload of ore that netted $1400 and another that netted $1270 were shipped from these workings, but because of the expense of mining through the winzes it was decided to drive another tunnel, lower in the vein, that also would be more accessible for the wagons in which the ore was hauled to the railroad. This tunnel, being driven toward the hanging wall, has not yet reached the vein.

The ore is lead-silver. The lead is mostly in carbonate form, with some galena, the amount of sulphide not increasing rapidly with depth. There is carbonate of lead at the bottom of the 110-ft. winze, showing that the zone of oxidation extends much deeper. The rich ore is in seams parallel to the bedding planes of the shale and the seams continue into the limestone as far as the fracturing exists. The average width of the fracturing is 8 ft. The silver content of the ore varies from ½ oz. to each per cent of lead in the richer ore to from ⅔ to ¾ oz. to each per cent of lead in the lower grades. Shipments show the gold value to be as high as $4 per ton, with 4% iron, 20% lime, and little magnesia. A 25-ton shipment to the American Smelting & Refining Co. had the following content:

Gold, 102 oz.; silver, 24.4 oz.; lead, 45.9%; copper,

PORTAL OF PADDY PRIDE TUNNEL

1.25%; zinc, 6%; sulphur, 8%; iron, 3.3%; insoluble, 11.8%. The smelting company paid $56.43 per ton for this shipment.

The ore is valuable to the smelters because it contains a large proportion of lime and some iron, so that a reasonable contract can be made for treatment and low-grade ore can be handled at a profit.

A METHOD of blasting a heading, possessing a new feature, is reported from the Nordhausen mining district in Germany. Instead of two or three inclined shot-holes in the centre to un-key the face of the work, the holes are bored parallel with the axis of the drift, locally known as 'canon-shots'. These are arranged and fired to make a hole of no great diameter in the centre of the face by crushing the rock. Then a ring of shot-holes is bored around this central opening and fired. This removes a considerable mass of rock, thereby greatly enlarging the central opening. Another ring of holes, more widely spaced, clears the face. The novelty consists in the closely situated central crushing holes. Being so near together, it is not necessary to have a primer and fuse in each. The concussion of one shot is sufficient to fire the rest

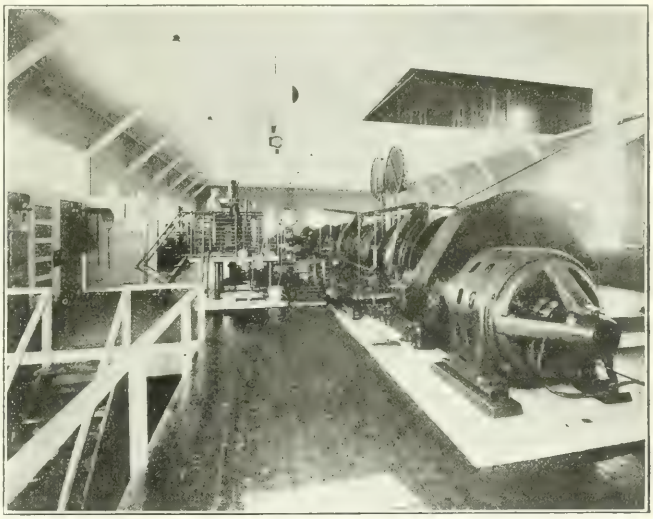
New Hoisting-Equipment at the Tonopah Extension Mine

*The Tonopah Extension Mining Co. has recently completed a number of improvements in its surface-plant, for increasing the capacity of its Victor shaft and permitting deeper mining under advantageous conditions. These improvements include a change-room to accommodate 156 miners, new bins for ore and waste, a 100-ft. steel head-frame, and a new building to house compressors of increased capacity, and a new electrically-driven hoist. A number of features in the design and construction of the hoisting equipment are of special interest.

The hoisting-engine was built by the Nordberg Manufacturing Co., of Milwaukee, and is of the double-drum type, each drum running loose on the shaft, with a hydraulically operated clutch and brake. The hoist is connected through a single reduction of herringbone gears to a 300-hp., three-phase, 440-volt, 60-cycle motor, running at 600 r.p.m. It was manufactured by the General Electric Co. The current is fed to the motor through a magnetically controlled switchboard. A Francke all-metal flexible coupling is interposed between the pinion and the motor.

The hoist was designed to handle, for continuous duty, when in counter-balance, a total load of 8 tons, which includes the weight of the rope, from a maximum depth of 3000 ft. Each part, however, is of sufficient strength to permit hoisting an unbalanced load when necessary. The drum-shells, which are cast in halves, are constructed of hard close-grained cast-iron. They are machine-grooved over the entire face for $1\frac{1}{8}$-in. rope, having a pitch-diameter of 72 in. with a winding-face of 66 in. The drum makes 54.8 r.p.m., giving a rope-speed slightly in excess of 1000 ft. per minute.

Hydraulic operation of brakes and clutches, together with automatic safety-devices, are important features and are marked improvements over many types of hoist that have preceded this design. The brakes and clutches are operated from the engineer's platform in much the same manner as with the direct-brake type of hoist. The brakes are applied by means of dead weights and are released by a direct-acting thrust-cylinder, the motive power for which is oil, from an accumulator, which is maintained at a pressure of approximately 105 lb. per square inch. The clutch-cylinders are of the differential double-acting type, applying the clutch on the forward stroke and releasing on the return. Oil is admitted to, and exhausted from, the thrust-cylinders by hydraulic valves so constructed that it is impossible for the inlet and exhaust-valves to be open at the same time; the arrangement of the mechanism is such that the movement of the hydraulic valves, and therefore the thrust-cylinders, follows absolutely the motion of the operator's lever. Whenever this lever comes to rest, the thrust-cylinders also come to rest and are securely locked in that position, due to the fact that both hydraulic valves



HOIST-ROOM AT THE VICTOR SHAFT. TONOPAH EXTENSION MINING CO.

are closed. Accordingly the operator has full control over the brake mechanism, in the same manner as he would with direct action of the brakes, but the operation is accomplished with less effort; it is more positive and permits of a smoother handling of the hoist.

The accumulator is a cylinder 40 in. diam. by 48 in. long, outside dimensions, provided with a vertical fixed plunger that permits the oil-filled cylinder to rise or lower. The oil-supply is maintained in the accumulator by two $1\frac{3}{4}$ by $2\frac{1}{2}$-in. direct-connected vertical triplex pumps. One of these pumps has sufficient capacity to operate the accumulator, the other being a spare. When oil is fed to the thrust-cylinders, the displaced oil causes a slight movement downward of the accumulator, as the oil drawn from the feed is in excess of that supplied by the pump during the same period of time. However, the

*Data furnished through the courtesy of John G. Kirchen.

capacity of the pump, working continuously, is in excess of the total amount of oil required for the periodic feeds to the thrust-cylinders so that the accumulator is usually held at, or near, the upward limit of travel, at which point a by-pass opens and allows the excess oil to return to a well from which the pump draws its supply, and to which all of the oil exhausted from the thrust-cylinders is returned. The accumulator has a travel of 36 in. on its fixed plunger, thus having ample reserve during periods when the feed to the thrust-cylinders may exceed the capacity of the pump, such as might occur during a series of closely intermittent starts and stops, or more especially when the clutches may be repeatedly shifted. The quantity of oil required to fill the entire circuit is approximately 50 gal. A light grade of dynamo-oil is used. The use of heavy oil should be avoided, especially under conditions of temperature that would tend to lessen its fluidity.

The safety-devices consist of a solenoid-operated valve that functions in connection with the brake-operating levers. A Welch controller works in connection with the solenoid, which will open the solenoid-circuit and automatically shut off the power from the hoist-motor under any of the following circumstances:

1. If the hoisting-speed exceeds normal at any point.
2. If the operator fails to slow-down the hoist at any predetermined and adjustable point, and further fails to continue to slow-down between this point and the landing-level.
3. In case of overwind.
4. If the operator fails to reverse the hoist after the skip or cage has reached the landing, or limit of travel.
5. If the power goes off for any cause.

Should any of the above conditions arise, the solenoid is immediately de-energized. The solenoid circuit is then thrown open, the hydraulic brake-valves opening simultaneously, and allowing the oil to be exhausted from the hydraulic-brake cylinders; and the brakes are applied by the dead weights, the entire operation occurring automatically, smoothly, and almost instantly. The solenoid, with its counterweights, is placed at the front of the engineer's platform, while the controller, together with the rest of the safety mechanism, is supported on the indicator-column and is driven from the drum-shaft by the same sets of gears and shafting that operates the indicators.

Lead and Zinc in Japan

Lead is mostly found in the form of galena, which is closely associated with zinc-blende ores. The principal lead mine in Japan is the Kamioka, in Gifu Prefecture. The Mitsui Mining Co. in 1918 produced at this mine 7,408,309 lb. of lead, says a recent Commerce Report.

Producers and smelters were buoyed up by the high prices ruling during the War and by the hope that strikes and political conditions in the United States, Spain, Australia, and Mexico, the principal lead-producing countries of the world, would create a world-wide shortage. However, this hope does not seem to have fully materialized, and the lead market has become quiet as a consequence. The increased cost of materials for smelting and higher wages has caused a considerable reduction in output as compared with 1917. If the 1919 figures were available they would undoubtedly show a still more noticeable decrease in amount and value, many of the companies having experienced financial difficulties. In 1915 Australia sold to Japan 24,599,868 lb. of lead ingots and slabs, valued at $1,102,933. The same year the United States sold to Japan 5,790,156 lb., valued at $248,307. In 1919, while imports of lead slabs and ingots from Australia had only increased to 32,366,341 lb., imports from the United States jumped to 27,239,280 lb. In 1914 Japanese consumption of lead was estimated at 43,753,000 lb., a great share of which was imported from Australia. In 1918 the estimated consumption had reached 144,025,000 pounds.

Only since 1913 has Japan engaged in smelting zinc. Prior to that time zinc ore was shipped abroad and the refined product then imported. The largest zinc mine is Hikoshima in Yamaguchi Prefecture. In 1918 the production of this mine was given as 27,672,960 lb. of zinc and 230,720 lb. of lead. The estimated consumption of zinc in Japan increased from 25,512,000 lb. in 1914 to 60,761,000 lb. in 1918. The estimated cost of production of refined zinc, at the smelters, is about $11 per picul (133⅓ lb.). Prices of 98% zinc ranged from $6.41 in June 1914 to $27.40 per picul in December 1915. Since then prices have hovered around $12 as an average. In March 1920 the price was $13.96 per picul. The margin of profit, considering transportation charges, is thus proportionately low at present. Yamaguchi Prefecture led in zinc production in 1918 with 27,672,972 lb., valued at $2,535,822. Fukuoka and Okayama followed in the order named, with over 18,000,000 lb. each.

In Japan, the principal uses of lead are for the making of paint, cables, and piping, and in producing acetic acid. The principal uses of zinc are for plating and making paints. In the mining of lead and zinc, primitive hand methods are used by the smaller companies. The operations of the larger ones, however, compare favorably with those used in the Coeur d'Alene, Idaho. There are 2364 miners employed in zinc mining, while 1046 are employed in lead mining. The Mitsubishi Kogyo Kabushiki Kaisha pay their miners an average of about 75c. per day, with two holidays per month. The underground miners work about 56 hours per week; surface workers usually have a 77-hour week. During 1917 and 1918 a great deal of zinc ore was imported for smelting, mostly from Australia. However, since 1918 imports of zinc ore have decreased considerably, owing to a smaller foreign demand for the refined article, thus causing many smaller smelters in Japan to suspend operations.

The exports of zinc ore have shown a steady decline since 1915, when they amounted to 13,618,250 lb. On the other hand, exports of zinc ingots and slabs increased until 1917, since when they have shown a noticeable decrease.

Flotation Processes

*The announcement that the Minerals Separation Company is ready to do business in the United States marks an interesting epoch in the history of the flotation processes. It is signalized by the formation of a company incorporated under American laws, with Mr. E. H. Nutter as manager. This method of concentration has hitherto received but little attention in America, chiefly because no one skilled in such operations has been on the spot to demonstrate the application of the principle involved. This disadvantage has now been removed, and metallurgists on the other side of the Atlantic will have an opportunity of judging for themselves. Concurrently with the establishment of an American branch of the Minerals Separation Company, the 'Engineering and Mining Journal' publishes an editorial in its issue of April 25, attacking the validity of flotation patents in general, and those of the Minerals Separation Company in particular. The 'Journal', after maintaining for five years an attitude of incredulity as to the practical value of a new-fangled notion, now shifts its ground, and argues that the same thing was done twenty years ago in the United States. Thereupon it recommends American metallurgists to go ahead for themselves, and not be frightened with threats of litigation on the part of the proprietors of the process now introduced to their notice. We abstain from making more than passing reference to the personal considerations that may explain this unfriendly attitude toward Minerals Separation, merely ejaculating, with Mr. Vincent Crummles, of immortal memory: "How *do* these things get into the papers!" How indeed! It is not for us to say. But seriously, and on general principles, we wish to warn American metallurgists that the history on which the article in the 'Journal' is based is incomplete and the application inaccurate. In our issue of September 1909 we published a detailed account of the various patents from 1860 onward, covering the selective action of oil, and the flotation by gaseous bubbles, oil, and surface-tension, and we recommend American metallurgists to read this article for themselves. A careful perusal of it will show that the subject is much more complicated than the editor of the 'Engineering and Mining Journal' would have it supposed. Of course, all these old attempts to utilize oil, acid, bubbles, etc., were perfectly well known to Elmore, Cattermole, and others who have applied themselves to this branch of metallurgy. For instance, Elmore only claimed the application of the principle to a freely flowing pulp, that is, he considered his invention to consist in the continuity of the process and in the use of large volumes of water. This claim was, however, not upheld in the English courts, although the German Patent Office recognized its novelty; while in Australia the decision of the law on the subject has not yet been reached. The Minerals Separation Company, which owns the series of patents of Cattermole, Sulman, Picard, and Ballot, bases its main claim on the use of minute quantities of thin oil for the purpose of creating the froth that collects and buoys the sulphide particles. Both of the belligerent groups have patents for modern applications of an old idea, and their patents will cause trouble to those who wish to work the processes on their own account. So we recommend American metallurgists not to be in a hurry to follow the 'Journal's' advice.

An editor may have some difficulty in deciding which line to follow: whether to fight for the perfect freedom of every process and so benefit metallurgists and operators generally, or to appeal for fair play to the individual metallurgist, who by years of thought and hard work has evolved a commercial process out of a chemical or physical idea. His decision is usually made according to the degree of reasonableness on the part of the inventor. If the inventor is too grasping, general resentment is aroused; but if he is reasonable in his demands, he ought to be allowed a legitimate reward. In the case of flotation processes, the owners are not avaricious; their terms of royalty and co-partnership are quite businesslike. There remains a further reason for recommending metallurgists not to embark rashly on the sea of investigation and invention for themselves, namely, the complexity and obscurity of the physical forces that underlie the phenomena of flotation. By all means let them make examinations of the problem, for we want more light on it—and less heat—both from scientific and practical men. But our advice is that they should not do it at the expense of a mine, for it will come cheaper to engage the services of an expert, who has had a few years of experience, and to pay him a reasonable royalty, than to spend time and money on research work in the hope of evolving a commercial plant that will dodge the payment of a small royalty.

There is another feature of the 'Engineering and Mining Journal's' advice that is open to objection. The question of the validity of patents is entirely one for the courts to decide, and it is useless for an editor to pass an opinion as to the legal standing of the various patents. If an editor has information that will help in the elucidation of an intricate dispute he is fully justified in publishing it, and in giving his interpretation of it, but to present an incomplete statement that practically evades the main question is only a trespass on the legal domain. In this connection it has to be remembered that several lawsuits are about to be tried in Australia and for this reason alone one-sided statements and comments by influential papers, though published on the other side of the Atlantic, are to be deprecated. The Elmore v. Minerals Separation case will be commenced on May 22. The Potter Company, which has the rights to hot acid solutions, is also bringing action against Minerals Separation. As for the De Bavay Co., nearly all the other patentees claim that its process, though not necessarily its patents, is an infringement of their rights, therefore we suppose that it would be to the interest of this company that every patent should be upset in Australia, America, and elsewhere.

*An editoral from 'The Mining Magazine' of May 1911, introduced as evidence before the Federal Trade Commission.

The Mines at Chuquicamata

*Chuquicamata, lying at an altitude of about 9200 ft. above sea-level, is at the end of a spur of the Antofagasta & Bolivia railway, about 14 miles distant from Calama, with which it has daily train connections. The latter town is 150 miles north-east of Antofagasta. The mines situated at Chuquicamata are the property of the Chile Exploration Co., a subsidiary of the American Smelting & Refining Co., and the present plant began production in May 1915. It is said that the works at both Chuquicamata and Tocopilla represent a total investment of about $100,000,000.

The mining operations are simple. The ore, ranging from 1.5 to 2% copper, is shoveled directly from the side of the mountain into the cars, which carry it down to the crushers. There are three different series of these. The contents of the cars, holding 90 tons, are dumped into the primary jaw-crusher, which breaks up the large pieces of the ore. Thence the ore is carried by belt-conveyors into storage-bins, from which it is drawn off underneath by belt-conveyors and sent to the gyratory crushers. These still further reduce the ore, after which it is passed to Symons disc-crushers. It leaves the latter in condition to be treated in the leaching-plant. Belt-conveyors, more than 1000 ft. long, carry the ground ore to the large leaching-vats, where it is treated with water. There is sufficient sulphur in the ore to form copper sulphate, without the introduction of sulphuric acid, although before this fact was discovered the company had installed an elaborate acid-plant, since abandoned. After four days the liquid copper-sulphate solution is drawn off and carried to the large tank-house, where the copper is deposited electrolytically in sheets, about 2 by 3 ft. in size. These sheets of pure copper are then hauled to the smelter, where they are cast into bars 5 ft. long and 5 in. thick, ready to be shipped.

The monthly production of copper is now between 3000 and 4000 tons, and an increase in the capacity of the plant is being planned. The cost of production per pound, including transportation to New York and selling costs, is about $0.145.

The company has two railway lines of its own on its property, one of standard gauge and another of the same gauge as the Antofagasta & Bolivia railway—in all, about 50 km. of track. Moreover, it owns 50 locomotives of three different types. Since the terminal of the spur from Calama is at Punta de Rieles, a short distance below the town of Chuquicamata, the company has constructed a track from this point into its own plant, thus making it possible to load the copper bars directly onto the cars at the smelter, and to unload all the materials brought in from the outside for the use of the plant. The entire product of the mines is shipped from Antofagasta, in part by the company's own boats and in part by independent steamers. However, the company is now seriously considering the building of a line almost due west to the coast at Tocopilla, which lies much nearer to the mines than does Antofagasta, and, moreover, is situated farther up the coast and therefore nearer New York.

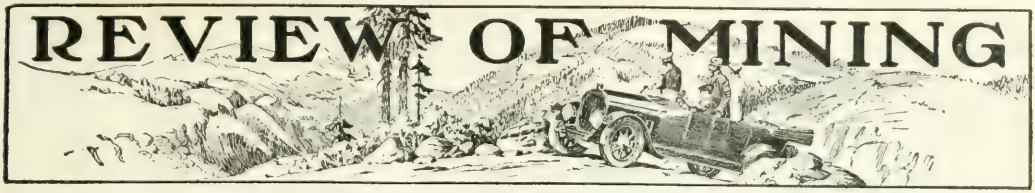
Power for the plant at Chuquicamata is supplied by electricity brought from the company's power-station at Tocopilla; 100,000-volt current is distributed through a large transformer station. Between 50,000 and 80,000 bbl. of fuel-oil is used at Tocopilla each month, and from 25,000 to 30,000 bbl. at the plant itself, largely for the smelter and the locomotives. The water for the use of Chuquicamata is brought a distance of 90 km. from near the base of the volcano of San Pedro. It is said that the building of this system alone cost $1,000,000.

Chuquicamata, or 'Chuqui', as it is generally known, is one of the largest mining camps in the world; the total population is about 10,000. The mine is situated two miles from the town and nearly 1000 ft. higher. The town itself is divided into three parts. On one side is the 'American town', consisting of the houses occupied by the American employees, the hospitals, the clubs, and the offices of the company. The American and English employees number between 200 and 250 and are employed on a three-year contract. Next to their settlement is the plant proper—the crushers, leaching-vats, shops, tank-house, electric station, smelter, etc., and beyond lies the so-called 'new camp', or town, where the workmen live. These laborers, consisting of both Chileans and Bolivians, are housed in neat and comfortable plaster buildings of which there are altogether some 1300. Wages range from 7 to 25 Chilean pesos per day (about $1.40 to $5). Homes for the American and better-paid Chilean employees are noticeably well built, equipped with heating apparatus and modern plumbing, and are furnished as attractively as possible. The total number of residence buildings at Chuquicamata is 1795. Visitors to the plant may stay at the 'Guest house', where excellent accommodations are supplied for 18 pesos per day.

A welfare manager has charge of the housing of all employees, as well as of sanitary conditions, amusements, and the general welfare of the native population of the town. There are public baths, and a sewage system covering the whole camp, and the sanitary regulations made by the welfare department are rigorously enforced. Two hospitals with attendant doctors and dentists are mantained by the company.

Education is furnished by two schools, one for American children, who are taught by American teachers, and another for the children of the Chilean workmen. Several hundred pupils attend the native school, which is housed in an attractive concrete building and equipped as well as any American school of equal grade. A church has also been constructed, and is in charge of a resident priest. Two club-houses are furnished for the American employees, one of which is said to be among the finest in Chile, possessing with other features a swimming-pool, dance-hall, bowling-alleys, and billiard-rooms. Other club-houses are available for the native laborers. A large theatre displays moving pictures for the benefit of the whole population of the camp. In addition, there are golf-links, tennis-courts, football-fields, and a race-track. The camp does not lack amusement.

*W. L. Schurz in 'Commerce Reports'.



FROM OUR OWN CORRESPONDENTS IN THE FIELD

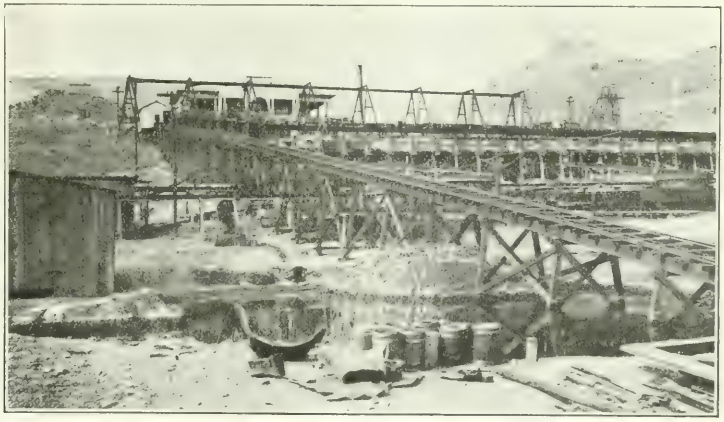
ARIZONA

CONDITIONS AT THE U. V. X. MINE.

JEROME.—The reverberatory furnace at the United Verde Extension smelter was blown-in last week and is operating satisfactorily. The roasting-plant is also in operation, and as a result of this expansion the Extension is adding to its smelter force. From a recent report issued to stockholders by the United Verde Extension on underground conditions it is learned that the ore-bearing area on the 1500-ft. level is approximately two-thirds the size of that on the 1400, and the copper content is about 6%. Development work on the 1600-ft. level has reached the orebody and it is understood that the first samples were in the neighborhood of 5%. Similar work on the 1700-ft. level will not cut the orebody for some time to come.

The tunnel at the Shea Copper Co. is now at a point immediately below the shaft and a station is being cut for the raise, which will be begun to connect the tunnel-level with the shaft 200 ft. above. In the meantime the tunnel will be advanced to cut the orebody developed on the 325-ft. level west of the shaft. The orebody is now dipping to the west and it may require as much as three weeks to advance the tunnel to the intersection. The width of the vein was determined when cutting the station and an interesting point is that the walls have changed from diorite to porphyry, the latter being associated with the orebodies opened on the upper levels of the mine. While the tunnel was being driven, a small crew has been at work on the stope west of the shaft on the 325-ft. level and several cars have been shipped to the Extension smelter. The ore coming from this stope is of as high a grade as any yet found in the mine and expectations are that with the additional depth afforded by the tunnel steady shipments can be maintained as soon as the new bore cuts the orebody.

AJO.—The New Cornelia Copper Co. has declared its second dividend of 25c. this year—the third since the initial payment, made the latter part of 1918. The New Cornelia is rapidly forging to the front as one of the leading copper producers. Ore shipments were commenced exactly three years ago. The New Cornelia is controlled by the Calumet & Arizona, through ownership of 1,229,741 shares of its 1,800,000 shares of outstanding stock. Dividend payments by New Cornelia therefore benefit Calumet & Arizona to a considerable extent. The recent 25c. dividend, payable August 23, will call for the distribution of $450,000. New Cornelia last year produced 39,509,000 lb. of copper, and sold 29,972,106 lb. The copper on hand at the close of the year was inventoried at 12½c. per pound. While the company last year showed a net income of but $17,246, this was after charging off $641,861 to depreciation and $897,144 to ore depletion. The sum total of these two charges alone was equivalent to about 85c. per share on the stock.



LEACHING-PLANT AT THE COPPER QUEEN MINE, BISBEE

OATMAN.—It is reported that the owners of the Gold Dust mine at Oatman are preparing to install a milling-plant. The company has machinery that can readily be converted into a plant capable of handling the product of the mines with small expenditure of money.

COCONINO COUNTY.—It is reported that plans are under consideration for the construction of a railroad that will run from Flagstaff to Winslow and thence through the northern part of Arizona to New Mexico, Utah, and Colorado points, in order to tap the rich coalfields and mineral deposits of Arizona and New Mexico, and also connect with eastern lines.

COLORADO

CAPACITY OF SMUGGLER UNION MILL BEING INCREASED.

LEADVILLE.—Mine buildings and equipment at the Ponsardin mine that were recently destroyed by fire, believed of incendiary origin, are to be replaced by the lessee, W. E. Bowden, and as soon as the new plant is in operation shipments of tin and lead will be resumed. The force at the Northern will be doubled immediately, according to S. M. Carleton, manager, and two shifts operated. The Rio Grande Railway Co. will re-lay track to the mine and ore is being stored underground rather than incur the high cost for haulage by team. A strong body of manganese ore was recently opened at the Newell shaft and is now under development. Operation of the District mill has been unsatisfactory and it is doubtful if the plant is kept in operation. The test run has shown the mill to be "expensive, inconvenient, and unsatisfactory", according to the manager's statement. Development is in progress by the C. & H. Mining Co. in the Graham Park section, operating through the Star of the West shaft in search of the Iron-Silver shoot believed to extend into this property.

TELLURIDE.—Shipments during July from the Tomboy mill totaled 60 cars of concentrate; the Smuggler Union billed out 35 cars. The last-named plant is turning out about 400 tons of concentrate daily. Work is progressing on the new flotation unit and when completed the Smuggler mill will handle 700 tons per day. Lessees at the Favorite mine at Ophir are shipping smelting-grade ore.

BRECKENRIDGE.—Fire of unknown origin destroyed the sawmill of the Royal Tiger company last week, together with timbers for mine and the new concentrating plant, now in course of construction. The delay to operations will be expensive. A flotation unit has been added to the plant of the Liberty Mining & Reduction Co. on the Pennsylvania group. Lessees who have been operating on the property shipped two cars to the A. V. smelter at Leadville last week. The electric-power line to the Deep Shaft mine of the Tymos company on Shock hill has been connected, and a second shift is cross-cutting to connect with the Brooks-Snyder workings for ventilation. With ventilation provided the Deep shaft will re-enter the shipping list after a long period of inactivity.

CENTRAL CITY.—A rich body of lead-silver ore has been opened at a depth of 35 ft. in the Alaska mine, above Black Hawk in Gilpin county, by the Midwest Mining Co. Rich lead ore containing native silver is being sacked, while the concentrating ore is treated at the Iron City plant with good profit to all interested. The Comstock, operated by a syndicate of Ohio capitalists, continues shipments of concentrate and smelting ore. The main shaft is to be sunk to greater depth and the property long inactive is to be thoroughly exploited.

Rich gold ore has been opened by former Cripple Creek men, on the Gold Rock in Russell gulch. The lessees, who have an option to purchase, are McLean and McCampbell. Ore uncovered at the 450-ft. level has given assay returns of 48.60 oz. gold, 100 oz. silver, and 15% copper, a total of $1100 per ton. The property was operated 13 years ago by the same McCampbell, who cut but passed up the narrow streak that is now yielding this rich ore. McCampbell carried up a short raise where the streak widened to 12 in. The stope is now 18 ft. in length with ore in both ends and overhead. The Rara Avis in Eureka gulch has been taken under bond and lease by Steve Hoskin, of Denver, and Kansas City associates. Electric equipment is being installed.

CRIPPLE CREEK.—The crew testing the formation in the north-east end of the district has drilled more than 1150 ft. and for 150 ft. change in the character of the rock has been noticed. Small seams of quartz, showing mineralization in pyrite with slight flourine stain, have shown in the core of the drill, and conditions are considered most encouraging. Progress is being made at the rate of about 20 ft. daily. Samples of the drill-core have been sent to Denver for assay.

MICHIGAN

RESUMPTION AT FRANKLIN ANTICIPATED.

CALUMET.—Calumet & Hecla, by August 18 or 20, will have caught up on unfilled orders for France. A recent order for that country, 1500 tons, called entirely for special shapes, including bars weighing 265 lb. to be used for wire-drawing, and billets of from 150 to 400 lb. each for seamless tubes. A small quantity of cake-copper, ordinarily used for sheets, also was included in the order. In the meantime, comparatively small orders for domestic consumers are being filled, the last of which was 350 tons. Shipments are about on a par with production and the curtailed operations actually leave a smaller surplus on hand than was reported a year ago.

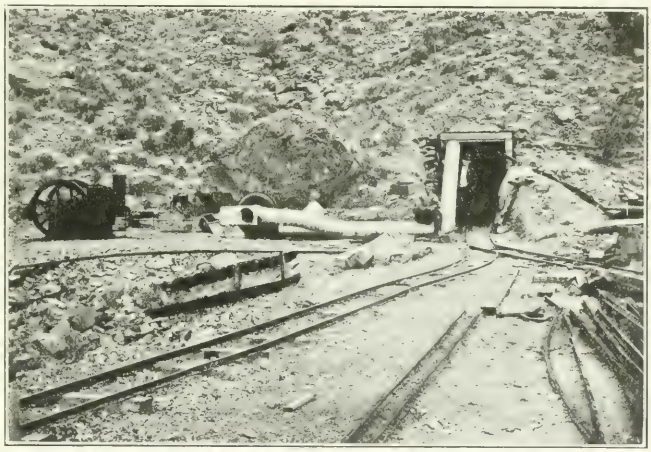
Planned improvements at the Calumet smelters have not gotten beyond the blue-print stage and as long as prices of material continue so high, it is not expected that work will begin. Construction work at the Calumet mills is confined to the erection of the addition to the flotation plant. With the extra equipment installed and in operation, a further recovery from the conglomerate tailing will be possible, as all the slime then will be treated by the oil-process. Only two-thirds of the slime-tailing is at present treated by flotation, yet the reclamation-plant is yielding 1,400,000 lb. of refined copper per month.

Allouez reports 11,120 tons of ore for July against 18,750 tons in June, and its shipments, representing the cleaning-up process in the stopes since its recent suspension, at present are not more than 250 tons per day, while Centennial's shipments have ceased completely. Superior in July shipped 1275 tons to the Osceola mill and LaSalle's July production was only 375 tons. Isle Royale has been making no overflow shipments for three or four months and its production is held at about 50,000 tons per month, all of which is stamped in its own milling-plant. Arcadian Consolidated is making splendid progress in the sinking of its New Baltic shaft from the 500 to the 900-ft. level, with two machines operating two shifts per day. The next project, once the sinking is completed, will be the driving of a drift south to connect

with New Arcadian's north drift on the 900-ft. level. When completed, the drift will be 3400 ft. long. On the 500-ft. level a cross-cut was driven 15 ft. to the vein, which revealed a width of 18 ft. and encouraging copper content. The showing, in fact, was as good as on the 400-ft. level where rock that will yield at least 25 lb., it is estimated, was opened.

Seneca reports a fair showing in Gratiot, while the miners freely assert that the developments during the past week are by far the best since the south drift on the 13th level started. The improvement in the level has been persistent and there is every reason to hope for a continuation of present or even higher grade as the drift approaches Mohawk No. 1 shaft boundary. In Seneca proper, preparations are being made to sink below the fifth level. Concreting keeps abreast with sinking and no delays will be experienced when capacity production begins. The drifts on the fourth level, north and south, are in excellent ground and on the third level, north, there is a marked improvement in quality.

Franklin shareholders on the lake are eagerly awaiting a resumption of operations at the property. From all indications the prospects of the mine were never better thant they are at present. Operations on the 39th level seemed to inject renewed life into friends of Franklin, for good prospects are known to exist 700 ft. north, and perhaps up to the 30th level. There has been no mill-test of the rock in the lower workings, but the mineralization was persistent from the shaft to a point 700 ft. distant, and the rock should assay 25 lb., refined, per ton. The operations in No. 1 shaft have been confined to the one lode, the Pewabic amygdaloid, while in No. 2 shaft the Allouez conglomerate is promising and may prove to be profitable.



PORTAL OF THE STERLAG TUNNEL AT STONEWALL, NEVADA

NEVADA

CONTROL OF SIMON SILVER-LEAD PROPERTY MAY BE ACQUIRED BY INTERNATIONAL NICKEL CO.

DIVIDE.—There is little doubt in the minds of many who have followed the Tonopah Divide developments closely that in a few months a report will be issued that will place the ore-reserves at a figure approximating that given by A. I. D'Arcy before he resigned as consulting engineer. It is said that in two or three months the mine is to be re-sampled in preparation for the issuance of this report and that until then the main effort will be to block out ore on all levels, particularly on the third, fourth, and fifth, where the south-east drifts are said to have been turned from the vein by the former management.

MINA.—Ore has been found on the hanging-wall side of the vein on the 550-ft., or bottom, level of the Simon Silver-Lead. A raise was driven on this level and at a height of 50 ft. the orebody was entered. The raise has been in ore for 15 ft. and a cross-cut on the level is expected to cut this ore within 40 ft. P. A. Simon, president, has denied the rumor that the International Nickel controls the company. He said, however, that the sale of a controlling interest to the International had been discussed and may be discussed again.

GOODSPRINGS.—T. J. Renaux has been appointed to succeed M. P. Cloonan as mill-superintendent for the Yellow Pine company. E. F. Gordon, of the Vanadium Corporation of America, and Oscar Hershey, of Burch, Hershey & White, consulting engineers of San Francisco, are here to inspect the vanadium-producing mines, the owners of which are seeking to find the best method of marketing their product. The Yellow Pine shipped during June, 21 carloads of zinc concentrate, 5 of lead concentrate, and 9 of zinc slime. Nine cars of ore were shipped from other mines.

GOLDFIELD.—The Development company has levied assessment No. 2, for 2c. per share, delinquent September 4. A. I. D'Arcy, vice-president and general manager, in a statement to stockholders, says that since June 16, when it was started, to July 30, there was delivered to the mill 4800 tons of ore of a gross value of $45,690, or $9.50 per ton. The last 800 tons treated before July 30 had a gross value of $16.20 per ton, according to the statement. Indications are that the extraction will be 90% and Mr. D'Arcy says, "as a matter of fact the tailing has shown an assay value of but 40c. per ton." He estimates the net profit from July 16 to July 30 at $12,000. The first large clean-up will not be made until September 15 and Mr. D'Arcy says "notwithstanding that our operations are showing a profit, it will be necessary to provide additional funds with which to meet payrolls, cost of supplies, settlement for custom ore treated, and other expenses falling due before we can realize on our bullion and con-

centrate shipments." He gives this as the reason for levying the assessment and by September 15 "returns should well exceed expenses and the operation show a tangible profit", according to the report. The mill is now treating 100 tons of ore daily, an average of 30 stamps being used. All of the crushing is done on one shift.

West Divide.—Zeb Kendall has bought the interest of Al McCoy and George Cook in the West Divide, a silver-lead prospect, and he is reported to control practically all of the stock with the exception of that held by L. L. Patrick. The cross-cut from the tunnel level at a depth of 150 ft. is being continued and a raise has been started. The cross-cut has passed the point where the vein should have been entered, according to the dip as indicated in the workings from the bottom of the 65-ft. inclined shaft, which cuts the vein. The vein dips east, and well west of the shaft there are two outcrops. If the most westerly of these outcrops is the vein cut by the shaft, then, according to surveys, the cross-cut at 150 ft. is still 20 ft. from the vein, and if this is true the dip is not as great as was estimated from the outcrop farther east. The cross-cut is approaching the foot-wall of the vein. Between the bottom of the shaft and the tunnel-level there is an intrusion of lime that has only a slight dip and it is also considered probable that the vein flattens and follows the lime, instead of continuing below it with a dip as indicated in the shaft workings. It is on this theory that the raise is being driven. The West Divide has become the centre of interest in Nevada because of the heavy buying of the stock on the San Francisco exchange by Mr. Kendall.

Tobar.—One hundred tons of silver-lead ore is being hauled daily from the Spruce Monarch to Tobar and Currie, 25 miles distant. Two caterpillar tractors and eight motor-trucks are being used. The ore is being treated in Utah smelters.

Eureka.—During the last 40 days 200 tons of ore has been shipped from the Croesus. There is a shortage of cars for shipping ore and this has been felt particularly by the Holly and Ruby Hill for two weeks.

Tonopah.—The tailing at the Tonopah Extension, West End, and MacNamara mills was covered with a thick coating of sand during a recent storm. Lessees had prepared the ponds for sweeping and treatment in the special plant of the Belmont for this purpose. The tailing is regarded as being lost for recovery by sweeping.

Stonewall Mountain.—The Yellow Tiger tunnel is 500 ft. long. A drill-sharpening machine is now being used. The stockholders have made a generous response to the call for assessment No. 2, according to Gordon M. Bettles, manager.

The Red Indian Metallic Point Co. has been organized at Reno to develop a deposit of red ochre, or 'paint ore', that is said to be 97½% oxide of iron. The president of the company is Charles R. Evans, Congressman from Nevada. The claims, which are five miles from the Sterlag tunnel of the Yellow Tiger, are developed by several short tunnels and shallow shafts.

NEW MEXICO

OPERATIONS AT BURRO MOUNTAIN CONCENTRATOR ARE RESUMED.

Burro Mountain.—On August 1 operations were resumed at the Phelps Dodge Corporation's Burro Mountain concentrating plant after a shut-down of 14 months, during which time the two-unit concentrator has been completely remodeled under the direction of H. Kenyon Burch.

The original mill as completed in 1916 was designed for 500 tons per unit, but the capacity was increased by minor changes, until at the time of the shut-down 700 tons per unit was being handled. Arrangement of plant at that time was: crushing-plant, No. 8 gyratory, grizzlies, and three vertical-disc crushers followed by three 54 by 24-in. rolls breaking to four-mesh. Each unit of the concentrator consisted of six roughing-tables, two duplex classifiers, four 48 by 96-in. rod-mills, and two more duplex classifiers. The classifier sand went to six sand-tables and the slime to six mechanical-flotation machines; all flotation tailing went to fifteen pan-motion vanners. Tailing from the six sand-tables was added to the vanner tailing.

Rearrangement of the mill as it is now running to handle 1000 tons per unit is as follows: crushing-plant, 3-in. grizzley, No. 8 gyratory, two 48 by 120-in. trommels to 1½ in., two vertical-disc crushers to 1½ in. Concentrator unit, two 78 by 150-in. rod-mills, seven roughing-tables, two duplex classifiers, four 48 by 96-in. rod-mills in closed circuit with two duplex classifiers. Slime from all classifiers goes to four pneumatic flotation machines, with the flotation tailing to 24 slime-tables. Flotation feed is 48-mesh. Three No. 7½ rotary blowers furnish air at 4 lb. pressure to all of the flotation machines, which are arranged with rougher and cleaner cells, all tailing coming from the roughers. Operations were resumed without mechanical difficulty, with a certainty that concentration will yield a higher extraction than was attained in the old plant. The flow-sheet of the plant as now operating is shown on the opposite page.

Electrical transmission-lines from the power-plant to the concentrator have been doubled to take care of the extra power required. The power-plant is now equipped with four Nordberg-Carels five-cylinder vertical Diesel-type generating engines delivering a total of 5000 hp. for all mining as well as concentrating requirements. A duplicate of the 4000-cu. ft. Nordberg-Carels Diesel compressor erected in 1917 has been added to ensure a continuous and economical supply of air for mining; the power-plant is completely equipped with Diesel engines and is the largest of its type thus far erected in the United States.

During the period of reconstruction at the mill, extensive development was carried out at the mine, 122,338 ft. of work having been done, with some churn-drilling from the surface. The result was a satisfactory increase in the grade and tonnage of ore-reserves and a more economical arrangement of tracks and equipment for underground haulage.

UTAH

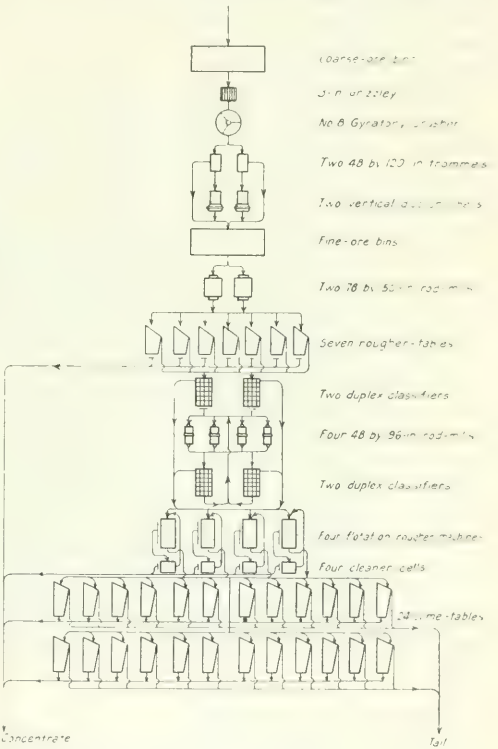
UTAH COPPER OPERATIONS.

SALT LAKE CITY.—During the second quarter of the current year, the Arthur plant of the Utah Copper Co. treated 1,428,600 dry tons of ore, being 145,300 tons more than for the preceding quarter. The ore averaged 1.213% copper and the average extraction was 82.8%, as against 1.233% and 86.14%, respectively, for the first quarter of the year. The production of copper from concentrate was 28,697,127 lb. and from leaching-plant precipitate 307,254 lb., making a total of 29,004,381, as compared with 27,257,546 lb. for the first quarter. The average cost per pound of net copper produced, including all charges except Federal income tax reserve and without credit for gold, silver, and miscellaneous income, was 13.697c., as compared with 13.202c. for the previous quarter. The value of the gold and silver was $234,544, while miscellaneous income amounted to $300,767. These items combined are equal to 1.929c. per net pound of copper produced. The total net profit for the second quarter was $2,240,470. A dividend of $1.50 per share, or $2,436,735, was paid on June 30, leaving a deficit for the quarter of $196,265, as compared with a profit for the first quarter of $433,855. The earnings for the second quarter were computed on the basis of 18.209c. per pound for copper, as against 21.994c. the previous quarter. The lower carrying price was due to sales of copper having been less than the quantity produced during the period, whereas during the first quarter of the year, the reverse was true. During the quarter there was removed 760,610 cu. yd. of capping, as compared with 839,713 for the first quarter. The Bingham & Garfield railway transported a daily average of 19,068 tons of freight during the quarter, as against 17,458 tons for the previous quarter.

PARK CITY.—The Park-Utah company made its first shipment in many months during the week ended August 7. The total output of the mines in this district for that week was 2308 tons, as compared with 1901 tons for the previous week. The Judge M. & S. shipped 721 tons; the Ontario, 540 tons; Silver King Coalition, 542 tons; Daly-West, 339 tons; Park-Utah, 64 tons; and Naildriver, 120 tons. The Judge smelter shipped 20 tons of premium spelter. At a special meeting of the stockholders of the Copper King Mining Co. on August 9, it was unanimously voted to consolidate that property with the Big Cottonwood Coalition Mines Co. This will give the new company about 400 acres of mineral-bearing ground. The property is situated in the Big Cottonwood district, and from recent reports indications are promising. Conditions continue to be good at the Iowa Copper property, small pockets of galena occasionally appearing in the face of the cross-cut on the 200-ft. level, according to David Scott, the manager.

EUREKA.—An offer to purchase the property of the Godiva Mining Co. has been made, and a special stockholders' meeting has been called for August 21 to consider the proposition. This is one of the old mines of the camp, and at present it is controlled by the Mechrystal interests. During the week ended August 7 the Chief Consolidated shipped 49 cars; Tintic Standard, 28; Dragon, 12; Eagle & Blue Bell, 10; Iron Blossom, 9; Mammoth, 9; Grand Central, 7; Iron King, 6; Gemini, 4; Victoria, 3; Swansea, 3; Gold Chain, 2; Centennial Eureka, 2; Bullion Beck, 2; Sunbeam, 2; Tintic Drain Tunnel, 1; Laclede, 1, making a total of 150 cars, as against 140 cars shipped the previous week.

Thomas O'Keefe has accepted the superintendency of the Griggs-Huish concentrator. Operations at the plant were started early in August, the material treated being the tailing from the May Day mill. The necessary connections to enable milling ore from the May Day and Yankee properties to be delivered direct to the ore-bins at the new plant have been completed.



NEW FLOW-SHEET FOR BURRO MOUNTAIN CONCENTRATOR

During the second quarter of the current year the Chief Consolidated Mining Co.'s development work totalled 6948 ft. of drifts, winzes, and raises. There was shipped a total of 20,071 tons of ore, yielding after smelting, transportation, and sampling charges, $407,993. The average assay of the ore shipped was as follows: gold, 0.07 oz.; silver, 25.57 oz.; lead in lead ores, 11.9%; zinc in zinc ores, 34.29%; zinc in zinc-lead ores, 16.77%, and lead in zinc-lead ores, 13.14%. The average gross value per ton of all ores was $39.44; smelting, freight, and sampling, $18.12, leaving a net value of $20.32.

After payment of all charges, the net profit for the quarter was $18,073. The cause of the large decrease in profits was the drop of 29c. per ounce in the price of silver, and the continuance of high operating, freight, and treatment costs. During the quarter there was paid out for additional mineral land about $57,000; this payment covering several small areas necessary to protect the company in its future operations. What is thought to be an entirely new ore-zone has been cut in the eastern part of the property. For some time, two drifts, several hundred feet apart, have been driven eastward on the 1800-ft. level. Recently work has been confined to the north drift, and at a point about 1500 ft. from the most easterly known ore deposit, the new zone was found. The point where this work is in progress is about 1200 ft. from the new shaft.

According to officials of the Pinion Queen Mining Co., the treasury now contains sufficient funds to continue development work which has been in progress for some time past. The shaft is now at a depth of 730 ft., and when the 900-ft. level is reached, sinking will be stopped temporarily to permit cross-cutting and drifting.

Since the re-timbering of the main working-shaft at the Bullion Beck property was completed, seven cars of ore have been shipped. Recently some additional leases have been given. There is still considerable virgin territory at this property, although the mine has been a producer for nearly 50 years.

Grand County.—Thirty years search for a rich gold vein has been rewarded by a discovery in Miners' Basin, about 35 miles from Moab. During that period W. I. Fowler and Robert G. Bryant have been prospecting every summer in an effort to discover the source of the rich float picked up in Miners' Basin. The find is reported to have been made in a mountain just south of the Tornado property, and the quartz ore assays as high as $2000 per ton. Dozens of locations have been staked during the past ten days, indicating that there will possibly be a revival of the boom of twenty years ago, when Miners' Basin boasted a population of several hundred people.

WISCONSIN

NEW JERSEY ZINC CO. MOVES PLANT.

Highland.—The New Jersey Zinc Co., which purchased in fee thousands of acres of land in this district for the purpose of mining for smithsonite is abandoning the camp after heavy investments in modern plants. The big deposits have been exhausted. Seven mills are being dismantled and the machinery removed to other districts in the field where the syndicate is now engaged in zinc mining.

Cuba City.—The Zinc Hill Mining Co., a South Dakota corporation, licensed to do business in Wisconsin, has increased its capital stock from $300,000 to $1,000,000. The increased capital will provide for two new zinc-concentrating mills; an all-steel magnetic separating-plant of the Louis Skinner rabble type, to cost $100,000; and a site for the new separating-plant. Charles Wolf, president and manager of the Zinc Hill Mining Co., is authority for the statement that it is the intention of the company to erect a zinc-smelter at some convenient point in the coal-belt of Illinois. Drills at work over a period of a year have prospected the hills in and about Cuba City and the east extension of the Raisbeck range has been proved over a stretch of a mile. It is said this will guarantee large zinc-ore production over a period of several years. The Big Dick mine, owned and operated by the Zinc Hill, is now producing at the rate of 50 tons of zinc concentrate on a single shift in the mill. Mechanics are engaged in erecting a new 100-ton zinc-mill, on the Lee farm south of and adjoining the Big Dick mine. The principal shareholders of Zinc Hill Mining Co. are Davenport and Waterloo (Iowa) capitalists. It is stated that the company has ample financial support.

Benton.—The Frontier Mining Co., now operating the Middie and Bull Moose mines, is dismantling and removing to a new site, near the Bull Moose mine, its 250-ton power, mining, and milling plant at the Frontier mine, where the ore has been exhausted. The Middie and Bull Moose mines are large producers of zinc ore and big reserves of milled ore are held at both mines. Rich strikes have been made by the Frontier Mining Co., on the Farrey-Whaley lands, the main deposit of zinc ore being 30 ft. thick. Drills are at work proving the Furlong farm, in Vinegar Hill township, near the site of the former Vinegar Hill mine, where outcrops of lead ore were found recently. The Frontier Mining Co. was originally incorporated under the laws of Indiana for $75,000. Later this was increased to $125,000; it has been one of the consistent dividend payers in the Wisconsin field.

BRITISH COLUMBIA

PREMIER TUNNEL CUTS VEIN AT A DEPTH OF 675 FEET.

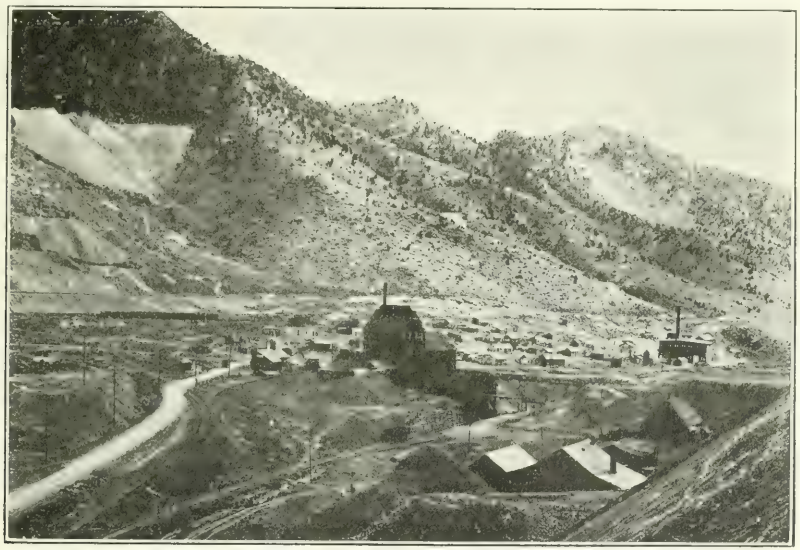
Stewart.—The most important news of the week is the striking of the ore-shoot at the Premier mine by a tunnel at a point 675 ft. below the outcrop. It will take time to determine the width and length of the shoot, but the quality of the ore is said to be similar to that in the upper levels. It has been decided to erect a cyanide-plant at the mine, and this and the concentrator probably will be in operation before the end of the year. The Algunican Development Co. is pushing exploration and development at the Spider, Northern Light, and Fitzgerald groups. Next to the Premier company, which is employing more than 150 men, the Algunican company is the largest employer of labor in the district. R. P. Thompson, of Everett, Washington, has struck high-grade silver ore at the Bayview group, on the hills near Stewart. He has established a camp on the property and is cutting a trail through difficult ground that entails a good deal of blasting. R. F. Weeks, of the Consolidated Gold Fields, Ltd., of South Africa, has been examining properties in the Alice Arm district. Mr. Weeks is said to have an option on a controlling block of stock in the McLennan Mines, Ltd., which owns the Royal group, ad-

joining the Dolly Varden property on the west. He will soon be prepared to make his report.

TRAIL.—The Emma mine, which was closed at the time that the copper blast-furnaces at the smelter were shut-down, is being re-opened. A force of 50 men is at work and it is expected that six cars of ore will be shipped from the mine each week. The Emma ore contains hardly enough copper to pay for mining and transportation, but is rich in iron, and consequently useful for fluxing the silicious ores. At the time the mine was closed, it was thought the Canada Copper Corporation would be shipping concentrate to Trail before this, and that the iron content of the concentrate would supply the necessary flux for the other ores. During the last ten days of July, 12,862 tons of ore and concentrate was received at the smelter, 10,916 tons coming from the Consolidated company's mines. The other shippers were: Bluebell, Riondel, 140 tons; Caledonia, Adamant, 3 tons; Florence, Princess Creek, 56 tons; Josie, Rossland, 349 tons; Mandy, La Pas, 870 tons; Monarch, Feld, 138 tons; North Star, Kimberley, 291 tons; Providence, Greenwood, 48 tons; and St. Eugene, Moyie, 51 tons. Total receipts for the year to date are 181,157 tons.

NELSON.—The Prospectors' Protective Association continues to gather strength. Local organizations representing the Grand Forks and Smithers districts have made applications to the central body for copies of the constitution and there is every reason to believe that they will become affiliated. It has been decided that the attorney-general shall be asked what action will be taken to protect prospectors' cabins and caches from the depredations of thieves. It appears that members of the association have been put to expense and annoyance in many instances by finding their headquarters in the hills rifled on returning from their periodical trips.

The Perrier Gold Mines Ltd., of Nelson, recently incorporated with a capitalization of $250,000, announces that the development of the Perrier, on Cottonwood creek, will be proceeded with. The property has been opened by two shafts, one being 120 ft. deep with a northerly drift 200 ft. in length from the bottom. There are two feet of good milling ore in the shaft and a similar width in the face of the drift. The smaller shaft, 40 ft. deep, has been sunk in four feet of milling ore. The latter is said to be similar to the product of the Athabasca and the Granite-Poorman, from 60 to 70% of the gold being free-milling. While there is a considerable body of ore blocked out, no stoping has been done as yet, the ore shipped having been taken out in the course of development. The present equipment includes a 150-ton milling-plant, a compressor, a friction-hoist, and a hydraulic pump, this being operated by water-power brought through a 2500-ft. eight-inch wooden pipe.



BULLION BECK AND CHAMPION MINES AT EUREKA, UTAH

VANCOUVER—John Hopp, well known as a hydraulic-placer operator in the Cariboo, states that, while British Columbians interested in this phase of mining appreciate government action in relieving them partly from taxation and the payment of royalty, they still are seriously handicapped. With camp supplies, fuel, and wages doubled in cost, the gold-mining companies are in difficulties by being compelled to market their product at an arbitray figure. "We miners," he said, "only wish that gold would be left free to have its price fixed by the law of supply and demand. The arbitrary price of $20.67 per ounce hits us hard. Only the best conducted plants can afford to operate and many placer men are just

holding on and not operating." He stated that the water has been late this year and that to make it worse there is a very rapid run-off which probably will limit the season to 90 days.

ONTARIO

LOW-GRADE CYANIDE IS WINNING FAVOR.

COBALT.—Low-grade cyanide manufacture by the American Cyanimid Co. at Niagara Falls is coming into general use in the Cobalt district, and to some extent is replacing the higher grade article manufactured by the Cassel Cyanide Co. of Glasgow, Scotland. The reason given for using the low-grade material is a saving in costs which more than compensates for the added inconvenience. This week it is announced that the Hollinger and the Dome, which are the two leading gold-mining companies in Canada, have each ordered a carload of the low-grade chemical with a view to carrying out detailed experiments. Arrangements have been made to explore the La Rose Consolidated ground by core-drilling, as part of a final scheme to tap all remaining prospective territory on the property. An effort will be made to commence taking ore from the Bailey Silver mine within the next month or six weeks. The Bailey mill, treating custom ore, is making from $2500 to $5000 net profit monthly pending treatment of the 23,000 tons of medium-grade ore estimated to be in sight at the Bailey mine.

Added activity is reported in the Elk Lake district, where the Triangle Silver Mines, Cane Silver Mines, and Parragon-Hitchcock properties are among those starting work. The Parragon has had 400,000 shares of stock underwritten and plans to install a small plant for treating its ore at the property. The Cane Silver Mines has been bought outright from its former Elk Lake owners. The La Rose Consolidated Co. of Cobalt has been asked to assist in financing the work, and a representative of this company is now examining the property.

A prosecution has been instituted against the Mining Corporation of Canada on the charge of conducting blasting operations on the Buffalo open-cut so as to endanger life and property. The neighborhood is thickly populated and it is alleged that owing to the neglect of proper precautions by the company the houses have been struck by falling rock involving serious danger to the residents. The Police Magistrate sent the case for trial to a higher court.

KIRKLAND LAKE.—The annual report of the Kirkland Lake for the year ending May 31 shows earnings of $159,777, operating costs of $135,278, and profits of $24,499. Little work was accomplished during the first five months of the year owing to the miners strike. During the period from January 1 to May 31 the mill handled something over 100 tons per day or two-thirds of its capacity, millheads during May averaging $12.03 per ton. On March 1 it was estimated that between the 300 and 700-ft. levels there was 120,000 tons of ore in sight, enough to keep the mill running at capacity for over two years, and later development proves that the orebody extends above the 300-ft. level, adding materially to this estimate.

The new mining plant of the Hunton-Kirkland has been completed and will be put in operation this week. Extensive development has been planned. The main shaft will be put down to a depth of 300 ft., at which point the first lateral operations will be started.

GOWGANDA.—A number of the companies operating in this camp have suspended work for the present, owing to the high cost of labor and supplies and the decline in the price of silver. Some of the companies are waiting for the construction of the light railway, the route for which has been surveyed for 20 miles, before resuming operations. The directors of the Big Four, who recently visited the property, have decided to employ oil-burning engines, as a means of overcoming the fuel difficulty. The company owns about 155 acres, comprising a large hill of rock, containing a net work of veins running in different directions. From the top of the hill a shaft has been sunk 40 ft. finding ore worth about $26 per ton, and a tunnel has been run into the side of the hill. In addition to silver the ore carries a large amount of cobalt. A vein 22 ft. wide, stated to carry 44% sulphur, has also been found and will shortly be opened up.

YUKON TERRITORY

THE MAYO DISTRICT.

DAWSON.—George P. Mackenzie, gold commissioner, recently returned from the Mayo district reports activity there. W. E. Cockfield and party, of the Canadian Geological Survey, have pitched camp near Keno hill, about ten miles from the Yukon Gold Mining Co.'s camp, and are busily employed in their investigations. Surface prospecting, which cannot be done during the winter, is being given most attention, with a view to finding suitable locations for the coming winter's work. The Yukon G. M. Co. has 20 men employed at this kind of work. The ore that was taken out by the company during last winter is being hauled to Mayo. Ore is being sacked from surface work on the Rico claim, where slabs of dense argentiferous galena weighing up to 1200 lb. are being found. Erickson & McKay have uncovered a four-foot vein of galena, which gives considerable promise. Mr. Mackenzie thinks there is sufficient ore in sight to provide work for the next two years with prospects for finding entirely new deposits.

It is hoped that there may be established this summer the continuity of the ore to a sufficient depth to ensure the permanance of the camp, and diamond-drills are being used for this purpose. When this has been demonstrated, the Government must provide proper means of transportation; present conditions being bad. Some veins with the best-looking surface indications have pinched out at comparatively shallow depths. Surface outcrops, however, have been demonstrated over such a large area that there will be much prospecting during this summer, followed by development during the winter, and it is thought that a reasonable proportion of the lodes will be found to persist to a sufficient depth to make mining profitable and to encourage the Government to construct the much-needed roads.

MINERALS SEPARATION LITIGATION

The Nevada Consolidated Copper Co. has admitted openly that it has infringed that patent of the Minerals Separation North American Corporation governing the use of oil in flotation in amounts less than 1% on the ore. This admission was made before Judge Hale in the U. S. District Court in Portland during discussion of a motion requesting further answers to interrogatories in connection with the infringement suit of the Minerals Separation Co. against the mining company. The period of infringement extended from September 1914 to August 1917 when flotation was used in Janney machines.

Suit of Mineral Separation Co. against the Magma Copper Co. has also proceeded another step, although the latter's motion for a bill of particulars has been denied. In this instance Judge Hale said: "It appears . . . an attempt to force from the complainant a statement of what his endeavor is to be upon certain material allegations in the bill. . . ." The litigation with the Magma company, as with Nevada Consolidated in the same court, has to do with two patents, one for the use of less than 1% oil and the other covering soluble frothing-agents. As matters now stand, each defendant must file before October 1 answer to the Mineral's Separation's bill of complaint. Suit against the Miami Copper Co. has been held up temporarily by the refusal of the Wilmington court to permit Minerals Separation to file a supplemental bill of complaint alleging further infringement and seeking an injunction for alleged contempt of court. The court in this case has demanded an entirely new suit be started unless the present case can be threshed out before the master who has been engaged for more than a year taking testimony for an accounting.

CALIFORNIA

Amador County.—Drifting in several directions is in progress on the 3500-ft. level of the Old Eureka, and 1500 ft. below the old workings. The latter part of the sinking was in soft rock, and good progress was made.——Sinking to the 3900-ft. level at the Central Eureka is completed, a station has been cut and levels will be started immediately.——All ore taken out of the 600-ft. winze in the Bunker Hill mine near Amador City is of too low grade for treatment, assaying not over $3 per ton.——Operations at the Keystone mine in Amador City have come to a standstill after the collection of two assessments. The plan of keeping the mine dry pending a change in conditions was found to be too expensive, so the mine is filling up. The cost of unwatering will be much less than the other procedure.

The Argonaut company continues to hoist and pump water, but the headway made is slow. It has been estimated that 190,000,000 gal. flowed into both mines in order to extinguish the recent fire. The Argonaut and Kennedy mines make 150,000 gal. in 24 hours. The former company has three No. 9 Cameron relay pumps, operated by compressed air, raising water to the 2000-ft. station, and from there an electrically driven Deane pump forces it to the surface. About 350,000 gal. is raised daily. The present water-level is just below 3300 ft. There have been persistent rumors of the Kennedy starting and also of a sale to the Argonaut people, but neither can be verified here. The Kennedy is idle in every department.——At a recent meeting of the Board of Equalization the assessment on the Argonaut M. company was reduced from $508,410 to $334,155, the Original Amador from $15,000 to $12,500, the Central Eureka from $172,000 to $106,890, and the Old Eureka from $65,125 to $50,000.

Nevada County.—Peter Delucci is building a two-stamp mill on his claim about two miles above Graniteville.——J. T. Blight and others nave taken a bond on the Delhi a few miles above Nevada City, and are preparing to develop the property. H. E. Sayers of Pasadena is making an examination.——W. A. Simkins has taken over all interest of Jack Harris in the Lily mine on the Mitchell ranch near Grass Valley. The Western Precious Metals Corporation has had the mine under development until recently and Simkins states that work will be resumed under his management.

Sierra County.—Joseph Mason and F. T. Meadery are making preparations to mine the East Fork of the North Yuba river half a mile above Downieville. The ground has never been worked.——Water has been drained from the 300-ft. shaft in the Gibralta gravel claim near Downieville and when re-timbered the ground will be explored to learn tne course of the channel.

IDAHO

Coeur d'Alene.—The Federal Mining & Smelting Co. is hoisting 900 to 1000 tons daily from its Morning mine, and shipping 3500 to 4000 tons of crude ore and concentrate monthly, according to Frederick Burbridge, general manager. About 425 men are employed. A raise is being made from the North Star tunnel level to the Independence tunnel-level, a distance of 450 ft. The work is being done in country rock, and it is expected to be completed within a month. The purpose of the raise is to provide an outlet to the North Star for ore from the Independence. All ore broken in the Independence will be removed through the raise and tunnel, and dressed in the North Star mill. Shipments from the Independence mine aggregate about 1000 tons monthly.

Three shipments made by the lessees in the lower workings of the Monarch mine in the North Fork district have netted good returns. From the three shipments $1178 was returned for 16 tons, $3067 for 38 tons, and $2668 for 45 tons.——Good indications are reported in the face of the tunnel being driven by the United Lead Mining Co. in the North Fork district. It is expected that within 80 to 100 ft. the drift will reach the orebody shown in the tunnel above. A. M. Nash is manager.——Eighteen men are employed by the Jack Waite mine. The company is using two trucks to haul the ore and has ordered two more. Two carloads have been shipped to the smelter.——A controlling interest in the Kill Buck Mining Co. has been purchased by the Chicago-Boston, which company recently acquired an interest in the Callahan Zinc-Lead company. The purchase is an important one, adding materially to the holdings of the Chicago-Boston. Some years ago ore was sold for $80,000, but the shipments seemed to exhaust the ore in sight and it has been a geological puzzle to know where the orebody is. ——Louden and Lane, who have been developing a group of claims near the divide between the head of the main fork of

Pine creek, say they have cut their vein at a depth of a little more than 100 ft. They report an orebody 2 to 3 ft. wide of galena ore with some copper.

UTAH

Bingham.—A serious accident occurred at the Utah Copper mine on the morning of August 13. Mine locomotive No. 14, while pushing a flat-car on which 10 Japanese laborers were riding, was struck by locomotive No. 29, coming down from one of the upper levels with 7 cars of ore. Two of the Japanese were killed instantly, and the third died within a short time, while the remainder of the party sustained minor injuries.

Washington County.—Sydney H. Ball, of New York, has been making an examination of the Silver Reef Consolidated property at Leeds. This property is to be developed by a syndicate headed by Frank T. Moorehouse. Mr. Ball expressed himself as favorably impressed with the project.

AN INVITATION TO TECHNICAL ORGANIZATIONS

The Joint Conference Committee of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, acting as an ad-interim committee in accordance with the authorization of the organizing conference held in Washington, D. C., June 3-4, 1920, extends to your organization a cordial invitation to become a charter member of the Federated American Engineering Societies, and to appoint delegates to the first meeting of the American Engineering Council, of which due notice will be given later.

There has been previously sent to you an abstract of the minutes of the organizing conference, at which there were in attendance 140 delegates, representing 71 engineering and allied technical organizations. It was the unanimous opinion of the conference that there should be created an organization "to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern in the engineering and allied technical professions" and that this organization should consist of societies or affiliations, and not of individual members.

At the gathering in Washington, which was the greatest event in the history of the engineering and allied technical organizations in this country, steps were taken which created 'The Federated American Engineering Societies', which will have a far reaching influence on the future of these professions. The fact that this action was taken without a dissenting vote indicates that the psychological moment had arrived and that there was a unanimous desire on the part of the representatives of these professions for the organization formed.

The Joint Conference Committee, the ad-interim committee, would ask each organization invited to take favorable action in the matter of membership in the organization at the earliest possible moment and to advise the Committee promptly of the names of the delegates who will attend the first meeting of the American Engineering Council in November of this year.

The Joint Conference Committee is confident that with the universally acknowledged need for such an organization, there will be a prompt affirmative response to this invitation.

Very truly yours,

JOINT CONFERENCE COMMITTEE
of
American Society of Civil Engineers
American Institute of Mining and Metallurgical Engineers
American Society of Mechanical Engineers
American Institute of Electrical Engineers.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Wendell T. Jones, of Salt Lake City, is in San Francisco.

Eugene G. Snedaker is in Denver, on his way to New York.

Herbert W. Pudan has returned from Mexico to San Francisco.

Fred B. Ely, of Fort Worth, Texas, was in San Francisco for a few days.

Milton F. Dodd, foreman of the Benguet mill, is on his way back to the Philippines.

Roscoe H. Channing, president of the Utah Consolidated Mining Co., is at Salt Lake City.

Frank A. Wichs is making an examination of the Glove mine, in Santa Cruz county, Arizona.

E. H. Clausen has returned to Berkeley from professional engagements in Colorado and Nevada.

L. J. Ingolfsrud, engineer for the Santa Gertrudis Co., at Fresnillo, Mexico, has moved to El Paso, Texas.

Arthur F. Taggart, professor of ore dressing at Columbia University, has been in Utah on professional business.

Raymond Bassett, chief engineer to the American Brass Co., has been visiting mining and metallurgical plants in Utah.

C. W. Newton, general manager for the Con. Interstate Callahan Mining Co., has returned to Wallace from New York.

E. W. Engelmann has returned to Salt Lake City, after a short trip to the Nevada Con. Copper Co.'s concentrator at McGill, Nevada.

J. Benton Leggat, general manager for the Argyle Silver Mining Co., of Montana, has returned to Salt Lake City from St. Louis.

F. C. Calkins, of the U. S. Geological Survey, is now in charge of a party surveying the mines of the Cottonwood mining district in Utah.

K. D. Koliasnikoff, until recently resident manager of the Kyshtim Corporation in Siberia, is in Utah, visiting mining and metallurgical plants.

Victor C. Alderson, President of the Colorado School of Mines, has returned from Scotland and England, where he investigated the oil-shale industry.

C. N. Shuette, recently superintendent of the Mariscal quicksilver mine, in Texas, has re-joined the staff of the U. S. Bureau of Mines at Berkeley.

Otto Sussman, vice-president of the American Metal Co., has returned to New York after a visit to the company's properties at Baxter Springs, Kansas.

George A. Laird, who has just returned to New York from Mexico, has been appointed general manager for the Guiana Development Co., and will leave for South America in September.

Charles H. Fulton has resigned the professorship of metallurgy in the Case School of Applied Science, at Cleveland, in order to accept the directorship of the Missouri School of Mines, at Rolla.

Ralph R. Woolley, hydraulic engineer to the U. S. Geological Survey at Salt Lake City, is investigating electric power-generating possibilities of the headwaters of the Green river in Wyoming.

Robert S. Lewis, Professor of Mining and Metallurgy in the University of Utah, has been appointed by the U. S. Bureau of Mines to conduct a six weeks investigation of copper deposits in Alaska. He expects to return to Utah early in October.

THE METAL MARKET

METAL PRICES

San Francisco, August 17

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	19.25
Lead, pig, cents per pound	9.25—10.25
Platinum, pure, per ounce	$115
Platinum, 10% iridium, per ounce	$165
Quicksilver, per flask of 75 lb	$85
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

August 16.—Copper is inactive but firm. Lead is quiet but strong. Zinc is dull but higher.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Aug. 10	95.50	59.37	July 5	89.97	51.68
" 11	94.62	58.37	" 12	92.18	52.66
" 12	95.37	58.75	" 19	91.04	52.91
" 13	95.62	59.25	" 26	92.39	54 77
" 14	95.37	59.12	Aug. 2	92.85	56.20
" 15 Sunday			" 9	94.58	58.39
" 16	95.87	59.37	" 16	95.39	59.05

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	....
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Aug. 10	19.00	July 5	19.00
" 11	19.00	" 12	19.00
" 12	19.00	" 19	19.00
" 13	19.00	" 26	19.00
" 14	19.00	Aug. 2	19.00
" 15 Sunday		" 9	19.00
" 16	19.00	" 16	19.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	....
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Aug. 10	9.00	July 5	8.39
" 11	9.00	" 12	8.25
" 12	9.00	" 19	8.45
" 13	9.10	" 26	8.93
" 14	9.10	Aug. 2	9.06
" 15 Sunday		" 9	9.00
" 16	9.15	" 16	9.06

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	....
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	....
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	....
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Aug. 10	8.15	July 5	8.04
" 11	8.20	" 12	8.15
" 12	8.25	" 19	8.24
" 13	8.35	" 26	8.22
" 14	8.35	Aug. 2	8.11
" 15 Sunday		" 9	8.12
" 16	8.35	" 16	8.27

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	....
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date			
July 20	90.00	Aug. 3	88.00
" 27	88.00	" 10	85.00
		" 17	85.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	....
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	....
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

CALL LOANS

With the exception of bankers and brokers and those who invest their surplus funds in market securities, most people seem to have a general misunderstanding of the laws and customs governing the various charges for the use of money. There is, however, sufficient justification for much confusion, when on the same day in New York City, discounts to a bank's customers are quoted at 6%, commercial paper in the open market at 7%, banker's acceptances at 5½%, call loans at 25%, and collateral time-loans at 8%. Probably the one item which has caused the most confusion during the recent months of high money is the call-money rate. When people see 30% money, for example, featured in the newspapers, there is a general feeling that the banks are doing a little profiteering and would stand investigation along the lines which have recently been prevalent in other businesses, says the 'Chemical Bulletin' of the Chemical National Bank.

Probably the only call-money market of national importance is in New York City, and it is there that collateral call loans are chiefly made. These loans are secured by pledge of investment securities, usually stocks and bonds dealt in on the New York Stock Exchange, and payable on demand of the bank or lender without previous notice. It can thus be seen that these loans are in an entirely separate class from those made by a bank to its commercial customers or depositors for usual business purposes. The claims of such clients have the first place in the eyes of the banker, not only in New York but in all cities, and it is only therefore the banks' surplus funds which are loaned on the Stock Exchange at call-money rates. The excess of loanable funds available for employment in this manner varies according to the country's commercial needs, which always have first consideration.

It is of course evident even in times of great stringency that some money must be loaned to finance the purchase and sale of investment securities, for if the investment market were at a standstill for lack of funds, commercial customers would suffer as well.

Since the position of call loans as compared with commercial borrowings has now been discussed, the legal aspect of the question is interesting. Most call loans are made in New York City, as stated before, and upon examining the Banking Law of New York State we find that Section 115 provides that "Upon advances of money payable on demand to an amount not less than $5000, made upon warehouse receipts, bills of lading, certificates of stock, certificates of deposits, bills of exchange, bonds or other negotiable instruments, pledged as collateral security for such re-payment, any bank may receive or contract to receive and collect as compensation for making such advances any sum which may be agreed upon by the parties to such transaction."

The rate for which call money is loaned by the banks is of course based largely on supply and demand. The old axiom, which applies to money in general, that "a temporary increase of the money supply in excess of the demand tends to lower the rate of interest temporarily, and a temporary decrease of the money supply, the demand not also decreasing, tends to cause the rate of interest to rise" is largely true in the case of call money.

MONEY AND EXCHANGE

Foreign quotations on August 17 are as follows:

Sterling, dollars:	Cable	3.65
	Demand	3.66
Francs, cents:	Cable	7.39
	Demand	7.40
Lire, cents:	Demand	5.05
Marks, cents		2.17

Eastern Metal Market

New York, August 11.

Mid-summer dullness pervades all the markets and there is very little business recorded in any of the metals. There are no indications of increased buying due to anticipation of higher freight rates.

The copper market is quiet but firm.

There is almost no business in tin.

Demand for lead has declined but prices are steady to firm.

There is no change in the zinc market which continues lifeless.

The antimony market is without quotable change.

IRON AND STEEL

The feature of the market as to buying-demand is the activity in pig-iron. The demand for iron, particularly steel-making grades, is perhaps more pronounced than at any other period this year. Consumers' demand is for both near-by and distant delivery. In the East it is said that over 50,000 tons of foundry, basic, bessemer, and malleable iron was sold recently.

The semi-finished steel market in Pittsburgh is easier with steel bars down to $79, and nothing higher than $75 has been heard of. A marked decline is not looked for because of increased costs due to higher freight-rates and resulting costs.

The July output of steel ingots was 2,802,818 tons according to the American Iron and Steel Institute's regular figures. This is the second lowest for the year. The total to August 1 this year has been 20,436,252 tons against 17,370,856 tons to August 1, 1919.

COPPER

This market is practically without change as to demand or prices. The leading producers continue to hold their price at 19c., New York, for both Lake and electrolytic. Domestic demand is confined to small lots for fairly early delivery and it is probable that these are being satisfied by outside dealers or small producers at 18.50 to 18.75c., New York, at which levels only small quantities are available. The fall in exchange the past two weeks has caused sales for foreign account to diminish. Indications are that copper output in July declined. Twelve of the largest producers have given out their figures and eight of them show a combined loss of over 5,000,000 lb. for June. The London market on standard copper, while showing increased business, eased off yesterday 5s. per ton on all positions.

TIN

The marked decline in foreign exchange, particularly the pound sterling, has had a distinct effect on the tin market as well as some influence on all the metals. The principal factor, however, has been the absolute lack of demand, consumers being entirely out of the market. Yesterday the metal was weak, declining about one cent per pound to 48c. New York for spot Straits, nearby futures being quoted at 48.25c. There was some willingness by sellers to make concessions, but it was without results, although there were some inquiries in the market on Monday. As a result of these conditions the market has been lifeless all the week, with the price-range confined to 48 to 49c., New York, for spot Straits. Yesterday the London market was £295 per ton for spot Straits against £288 a week ago. This grade is quite scarce in both markets. Business on the New York Metal Exchange has been light this week.

LEAD

The market is dull. It is, however, statistically strong because of the continued scarcity of nearby deliveries, although this condition has eased to some slight extent. The American Smelting & Refining Co. maintains its price unchanged at 8.25c., St. Louis, or 8.50c., New York. All the business done here being by outside sellers at around 9c., New York, or 8.75c., St. Louis, which we quote as the market. There have been some sales, however, as high as 9.10 to 9.20c., New York. The import lead reported to be headed for New York from England has not yet been a factor.

ZINC

Prime Western for early deliveries is unchanged at 7.80c., St. Louis, or 8.15c., New York, the latter being largely nominal. Sellers' offerings are light, and not much activity is reported. The business of leading producers is confined to business on contract and to hand-to-mouth orders. Zinc ore continues strong at $46 to $47.50 per ton with as high as $53 paid in some districts. There is little if any profit for most producers at these levels and they are confining their business to nearby shipments and regular customers. There is nothing heard about the effect of increased freight rates.

ANTIMONY

The market is very quiet and quotations for wholesale lots for early delivery are unchanged at 7.25c. per lb., New York, duty paid.

ALUMINUM

The virgin metal, 98 to 99% pure, is quoted in wholesale lots for early delivery at 33c. per lb., New York, by the leading producers and at 31.50c. per lb. by other sellers.

ORES

Tungsten: There is little activity in this market. Inquiry and sales are both light and quotations are unchanged from those reported a week ago, that is, from $5.50 per unit up, depending on the grade and the quantity as well as the delivery.

The ferro-tungsten market is quiet and unchanged at 80c. to $1.15 per lb. of contained tungsten.

Molybdenum: There is no change in conditions with demand light and prices nominal at 65 to 75c. per lb. of MoS_2 in regular concentrate.

Manganese: The market is quiet and stale with 75 to 80c. per unit asked for high-grade ore and 70c. the highest that users are willing to pay. There appears to be an ample supply because of the heavy importations of the last few months.

Manganese-Iron Alloys: The ferro-manganese market is quiet with demand confined to small lots for early delivery, sales of which have been made at a range of $200 to $225. The forward-delivery market is fairly firm at $200, delivered. The production in July, according to the blast-furnace reports of 'The Iron Age', was 29,864 tons, or the largest for any month this year. The spiegeleisen market is exceedingly strong at $80, furnace, with demand good. The production in July was 6925 tons, relatively a small output.

There has been a definite change for the better in the market for silver and it is believed that we have passed the period of depression. Demand is still not of very large magnitude; but the optimism in the market is justified, says Srinivas R. Wagel, 33 Pine street, New York. An important development is the premium for forward in London, where prices are being maintained by the Indian demand. China is also reported to have bought small lots in London. There has been a material improvement in the local market; demand for arts is increasing, especially as no purchases have been made for the past two months. The total of the Treasury purchases now amount to 10,000,000 ounces.

T. A. RICKARD, - - - - Editor

UNDER 'Discussion', we publish a letter from the Secretary of the Institution of Mining and Metallurgy explaining that the gold medal of that society was given to Mr. Sulman not on account of his recent paper on flotation but "in recognition of his contributions to metallurgical science". We accept the apology!

TO the Canadian Department of Mines we are indebted for the description of the Knee Lake district in Northern Manitoba. This part of the North-West does not seem to be particularly promising, but it is well to place on record the sort of information that would be useful to anyone desiring to prospect in that region.

IN fairness to Dr. Alderson and ourselves, we draw attention to a typographic error in our last issue, where the yield of oil from Scottish shale is given as 20 barrels; and from American shale, one half of that. The first figure, of course, should be two, as is indicated by the subsequent references to a yield of one barrel from American shale.

PERSISTENCE of rich ore in depth at Butte is indicated by the fact that the bottom of the Steward shaft is in a vein six feet wide that assays 8 to 10%. The valuable mineral is bornite. This is at a depth of 3750 feet. Whether due to primary deposition or secondary enrichment, it is highly satisfactory to note this promise of a long life for the mines of the Butte district.

IMMIGRATION is increasing. More than 5000 arrivals per day are being recorded at Ellis island, says the Department of Labor. Despite unfavorable conditions, 800,000 immigrants have landed during the twelve months ending on June 30, as compared with 141,132 during the corresponding period immediately preceding. The record was made in 1907, when 1,285,389 landed on our shores. We welcome this resumption of immigration on a large scale, provided the newcomers are scrutinized with care, so that only material suitable for citizenship is admitted.

ZINC stocks in the hands of the smelters on June 30 amounted to 29,892 tons only, as compared with 36,793 at the beginning of this year and 59,651 tons on June 30 of last year. This shows a 50% decrease in stocks during the twelve months, and is decidedly reassuring, for even in normal times a surplus of 35,000 tons is not unusual. Eighteen months ago the market was staggering beneath the big stock of zinc accumulated at the mines and smelters under the stimulus of war prices. The surplus at that time was as much as 75,000 tons, and constituted a real menace to current production. Since then operations at the mines and smelters have been severely curtailed, so that on June 30 last only 95,000 retorts were in action as against 107,500 on January 1. Later, strikes and shut-downs have caused a further contraction in the scale of operations. Export business is insignificant, and is likely to continue a negligible factor.

LAST Friday Mr. David P. Barrows, president of the University of California, gave the Commonwealth Club the impressions he brought home from his recent visit to Europe. He made them vivid to his audience. Among other things he spoke of the work of feeding the under-nourished children of Europe as it is conducted now by Mr. Hoover's organization, more particularly in Vienna. The administration of the funds placed in Mr. Hoover's hands by the United States is so efficient that the overhead expenditure is barely 1%. What a model to other organizations for charity! Here we may mention how instant is the applause elicited in any assembly of intelligent people by the mention of Mr. Hoover's name. It is safe to say that the appreciation of his work in Europe, and in his own country, goes far to measure the intelligence of an audience. In speaking of the present sad plight of Europe, and of America's vital interest in the preservation of European civilization, Dr. Barrows referred to the aid to be given by our "reserves of trained young men". Yes, that reserve is, or can be made, as valuable to the countries devastated by the War as our reserves of capital or food, if it is accompanied by intelligent sympathy, not the vacuous aloofness advocated by Senators Borah and Johnson.

SEMI-OFFICIAL statistics issued at Berlin give the total German loss of life in the War as 2,243,364. This includes both army and navy. The army lost 1,718,608 in dead and missing. Again we are reminded of an appalling feature of the War, namely, that the Germans killed nearly twice as many as they had killed on their own side. The British lost nearly a million, the French 1,350,000, the Russians at least 1,000,000 in their fighting with the Germans. That makes about 3,250,000 deaths in the armies of the three Allies. Deducting losses against the Turks and Bulgarians from the British and French totals, and making a similar deduction for German losses

in fighting the Americans, Italians, Serbians, and Rumanians, we arrive at the horrible conclusion that the Germans suffered only half as much as the French and British combined. The disparity in lethal destructiveness probably was most marked in the early period of the War when the Germans were relatively better equipped with death-dealing devices.

CONSUMPTION of gasoline in the United States during the first five months of the current year has been 26% more than it was in the corresponding period of last year, according to the U. S. Bureau of Mines. The total consumption was 1,418,534,063 barrels as against 1,127,879,649 barrels in the like period of 1919. Of our imports of crude oil in the fiscal year ending June 30, 2825 million gallons, out of a total of 2826 million gallons, came from Mexico. We imported a million gallons of crude oil from Trinidad and Tobago. We exported over 354 million gallons of crude oil, of which Canada took 308 millions. We also exported 690,859,418 gallons of refined oil, besides 205,057,450 gallons of bunker-oil laden on vessels engaged in foreign trade. We imported 81,888,904 gallons of refined oil. Of the refined oil, Great Britain took 205 million gallons, and Canada 146 millions. Our exports of crude oil increased 190 million gallons over the fiscal year 1919, whereas our exportation of refined oil decreased by 208 million gallons.

BOOKS are written in a hurry sometimes; for example, on the eve of a Presidential campaign. Mr. Max von Bernewitz writes with a good deal of feeling to protest against some careless statements appearing in the story of Mr. Herbert Hoover's life as printed in the 'Sunset' magazine. Of course, the suggestion that Mr. Hoover or anybody else from the United States introduced the single-hand drilling practice into Australia is ridiculous; it was introduced into Australia, and into California, by the Cornish miners before Mr. Hoover was born. If Mr. von Bernewitz waxes wroth, it is due partly to the fact that he is a New Zealander by birth and is solicitous for the reputation of the Australasian mining engineer. Of course, the Hoover stories written by Messrs. Vernon Kellogg, Charles Field, and others far less competent, have contained many exaggerations, provoked by their enthusiasm and condoned by their lack of knowledge concerning the technology of mining. The pity is that these writers did not submit their manuscript, if not to their victim, at least to some competent mining engineer, and one acquainted with Mr. Hoover's career in foreign lands. The typewriting incident in the office of Louis Janin, as related by Mr. Kellogg, for example, is entirely apocryphal. The fact is that Mr. Hoover has done so many big things well that no exaggeration is needed in order to make a good story. That by Miss Lane and Mr. Field is much the best. We have read it with keen pleasure, particularly the account of his parentage and childhood. His origin and rearing are truly American, and go far to explain the personal characteristics of the most distinguished of living Americans, a man who proved himself the most useful man in the world during the great crisis of civilization.

HOW much money is being diverted from necessaries to the creation of luxury in these days is suggested by an item in the New York 'Times' stating that in July plans for only one apartment house and one dwelling were filed in Manhattan as compared with plans for five theatres, 115 garages, and three loft structures, indicating that the urgent need for adequate housing is being neglected in favor of facilities for joy-riding and entertainment. Normally New York adds 20,000 apartments per annum, in addition to two-family houses and hotel apartments. Similar conditions obtain in San Francisco and its suburbs; there is a great lack of the small houses that make homes for young people. To this deficiency must be added the tremendously increased cost of domestic service, which now has risen to such a point as to make it almost prohibitive for a young couple on a small income to have a servant, thereby throwing a burden on the mother that threatens the very foundations of a progressive people. The ideal of a civilization like ours is a comfortable and well ordered home; without it a young married man is heavily handicapped; without it the production and development of good citizens is rendered difficult, if not impracticable. It is a curious thing that these basic factors in the welfare of the commonwealth are habitually disregarded.

MECHANICAL ventilation for the 29-foot twin tubes that are to constitute the new vehicular tunnel connecting Manhattan with Jersey City will be supplied by 65 electrically driven blowers, which will be capable of completely changing the atmosphere every two minutes. The longest span between ventilating shafts is 3800 feet, while the length of the entire tunnel from entrance to exit is to be 9425 feet. It is to be noted that the traffic through the tubes will be almost exclusively by motor, although at the outset horse-drawn vehicles will be permitted to use them. Research conducted by the U. S. Bureau of Mines at Yale University established the fact that the only substance in the exhaust of a gasoline engine that is toxic to an appreciable degree is carbon monoxide. This is also the dangerous product from the explosion of the dynamite used in metal mining, and for this reason the investigation by the Bureau was particularly appropriate. It was demonstrated that four parts of carbon monoxide mixed with 10,000 parts of air produces no harmful effects on the human system during an exposure of one hour; six parts may cause slight discomfort, but eight parts of carbon monoxide are required to be really injurious. Since the maximum time for the slowest trucks to pass through the tubes is 45 minutes, complete safety will be assured if the maximum contamination is limited to four parts in 10,000. This work by the Bureau has been the means of reducing the cost of mechanical equipment as originally planned by 25%, with a corresponding saving in operating expense. Some of the blowers will force fresh air into the tubes while the

remainder will act as suction-fans for withdrawing the foul air, the two principal stations being placed on piers at either side of the navigating channel. One of the important factors in determining the diameter of the tubes was the cost of ventilation. The annual outlay for power required by the 29-foot tubes is estimated at $280,000, whereas tubes 27 feet in diameter would have entailed an expenditure of $529,350 for electric current. The fresh air is introduced in the sector of the tube beneath the traffic-way while the contaminated air is withdrawn through gratings into the passage above. For economical operation, the tubes must be proportioned so that a tendency for 'wire-drawing' may be avoided. This has been accomplished by the 29-foot design. These tubes will be the longest, although not the largest, in existence; they will be lined with cast-iron; they will cost $28,670,000; the project will be completed in 1924; and ten years later the tunnels, it is estimated, will be used by 12,900,000 vehicles annually, or 3500 per day.

Cornish Mining

The mining of tin in Cornwall is in a parlous state. Therefore efforts have been made recently to obtain the aid of the British government in behalf of the industry. A representative deputation, according to 'The Mining World', waited upon the president of the Board of Trade with a plea for financial help in the development of new mining enterprises. The reply was that no public money was available for the purpose and that it was advisable for the necessary funds to be subscribed privately. The answer of the Government is not at all surprising, nor do we believe that a governmental dole is the proper stimulant for a decaying industry. Mr. Oliver Wethered, the president of the Cornish Chamber of Mines, sounds the right note when he says, according to 'The Financial Times', that he is firmly determined to make no further effort to move the Government to re-consider its decision, but that he is "more than ever convinced that there is a great future for Cornish mining". Mr. Wethered's cheery optimism, plus the force of his engaging personality, have been greatly influential in Cornish mining affairs during the last decade, and we feel sure that his leadership is one in which the 'old county' can place implicit trust. Of course, the fall in the price of tin, together with the increasing cost of labor and supplies since the War, has been a great blow to Cornish mining. In 1918 tin was worth £400 per ton; in June the price was £235. The doyen of Cornish mines, Dolcoath, is looking 'poorly' in the bottom, but East Pool, South Crofty, Geevor, and Levant are in vigorous health. As the editor of the Bulletin of the Canadian Mining Institute says: "There are many in all parts of the world who would regret the passing of this historically interesting mining centre. Directly and indirectly, the mines of Cornwall have contributed enormously to the advance of mining practice in all parts of the world." Yes, indeed, the 'Cousin Jack' has been the real professor of mining to many peoples. When it comes to working in hard rock and in tight places, there is no one like him. He has penetrated to the uttermost parts of the earth and left his mark in every corner. From him the Phoenicians bought tin in B. C. days and to him the world will look for tin, and other metals, in the years unborn. That old worthy, William Pryce, writing in 1778, said: "Supereminently this little province of Great Britain deserves to be ranked amongst the first principles of this island, as a nation and people, whose very name, according to the ancient authority of Bochart, and the later opinion of Boerhave, is derived from Bratanak, which, in the Phoenician language, signifies the Land of Tin." After citing various authorities, he states: "We may, hence, conclude it very probable, that this part of Great Britain was the first resorted to by the most ancient maritime powers in Europe and Asia, on account of its valuable, beautiful, and precious Metal; and therefore gave a name to the whole island, with some little variation, it retains to this day, and proves the antiquity, locality, and superiority of our product, and its universal supply for the use of mankind." From Dr. Pryce's 'Mineralogia Cornubiensis', from which we have been quoting, we get an idea that is pertinent to the immediate subject, namely, the decay of the industry. He says: "We hope the landowners will hold us excusable when we assert upon the clearest conviction that they contribute by their heavy exactions to deprive the industrious adventurers of too large a proportion of that profit which ought to be applied to the encouragement and reward of their arduous and expensive undertakings." Of course, a detached observer in California is not likely to know much about conditions in Cornwall, but it is a fact that we have heard or read somewhere that the 'lords', or landlords, around Camborne and Redruth do take too large a proportion of the profit that ought to go to the adventurers, or shareholders, and we suggest that one way to encourage the resuscitation of the Cornish mining industry is to persuade, not the Government, but the landlords to forego some of their perquisites in order not to kill the goose that lays their golden eggs.

A Western Engineer

In this issue we resume our series of interviews with representative members of the profession. Our victim this time is Mr. Albert Burch, who embodies the best traditions of Western mining. He was born in the prairie-lands of Nebraska, far from any mines, and not even within sight of any mountain that could suggest either geologic disturbance or prospective digging. Like many others he entered mining through the door of surveying, in his case it was railroad work. He followed the rails into a mining district and shortly afterward was given an opportunity to survey the workings of a mine, in Utah. That marked the beginning of his career as a mining engineer; he did not graduate from a school of mines nor undergo any special academic preparation; he became a mining engineer by doing the work of a mining engineer, which, unquestionably, is one of the most

effective methods of qualifying for the profession. He is one of those useful men who, starting with nothing more than high-school instruction, have made the most of the greater school of experience, aided by persistence and native intelligence, plus character. He became proficient technically by dint of study during spare time; to technical science he added an understanding of his fellowmen—an essential knowledge. The leasing of a small mine on his own account was an experience that must have helped greatly in equipping him as an adviser to others. It was a personal venture—an adventure—and it gave him, we surmise, a first realization of the economics of mining and a keen appreciation of the fact that the basic purpose of mining is to make money, not to furnish jobs for excellent young men. The appointment to the superintendency of the Bunker Hill was an important event in his life, because it enabled him to prove his metal and enlarge his acquaintance among men of importance in Western mining. Mr. F. W. Bradley tells us how he came to know Mr. Burch through an experience that they shared while traveling in Oregon. They were overtaken by a snowstorm so violent that two of their horses succumbed, but eventually they reached the shelter of the cabin for which they were making, because Mr. Burch broke trail with indomitable courage. He showed similar courage and persistence while in charge at Kellogg; he used to go through the workings of the Bunker Hill twice a day. A capacity for hard work and long hours has stood him in good stead ever since. Fortunately he has been blessed with a fine physique, rendering him capable of great exertions. Mr. Oscar Hershey, his partner, tells us how as geologist to the Bunker Hill company he was called upon to take Mr. Burch into the field and show him the evidences of faulting. He led Mr. Burch first as rapidly as possible to the top of the highest peak in the district, and thereby ascertained that his associate's reputation for endurance was justified. In Colorado, one may notice the great number of wagon-roads leading to insignificant prospects, the cut made for the road in several instances being deeper than the shaft. A mine-owner is said to have been asked to explain the anomaly. "Well", he replied, "you know here in Colorado we can't get an engineer to visit our mines unless we haul him up in a buggy." That may be apocryphal; evidently it is archaic; but in any event it does not apply to Mr. Burch. He would go on foot or on snowshoes, in a submarine or an aeroplane, if necessary, to reach his objective. He is extremely active in his profession. When we meet him at intervals, on train or ferry, on his way to and from his office, we learn usually that he returned to town yesterday and is leaving tomorrow or the day after. He seems rarely to 'take five', or 'taper off', as the Cousin Jack says. Capacity for hard work will go far, but it is not enough. Our friend has powers of keen observation, quick thinking, and good judgment. An excellent engineering equipment, the reader will say. Besides these he has a good temper; he is not easily ruffled and is kind to those with whom he comes in contact. Another of his associates says that the only time he saw Mr. Burch lose his temper was at the close of a long hard trip over a muddy road in central Idaho. The driver persisted in whipping the horses, although it was manifest that they were doing their best. Finally they stalled. The driver proceeded to use his tongue and his whip with equal violence. Mr. Burch expressed his opinion scorchingly, and later ordered the staff at the mine to give the driver no more business. A decent consideration for mankind is shown in his replies to our queries dealing with the labor problem and welfare work. At Kellogg, Goldfield, and Plymouth he did much to establish pleasant relations between the company's representatives, the employees, and the people of the town. That is good management; without good-will all round it is impossible to ensure efficient work; the disagreements that cause so much loss of time and money are like the screw-driver thrown by a vicious man into a delicate mechanism. Mr. Burch succeeded in his welfare work, as it is now called, because he was sincere in his purpose. Many similar attempts by company officials, presidents, managers, or superintendents have failed because they lacked the genuine humane interest in the workers without which welfare work is a Dead Sea apple, or, to use the vernacular, proves a lemon. The 'open shop' is a question that tests intellectual honesty, for most employers and managers do not face its implications fairly. If capital is organized, it is well that labor should be organized also, in order to facilitate collective bargaining. The 'walking delegate', of course, prostitutes a workable arrangement to his own selfish purpose, using his agency to promote trouble rather than to smooth difficulties. Mr. Burch talks good sense on this matter. He has a characteristic that is the mark of the truly scientific mind, he is intellectually honest; he does not 'kid' himself, as many well-meaning people do. Thus he is quite frank in deprecating the present method of obtaining evidence in apex suits; he suggests special courts for such litigation. We commend what he says to our readers. He is equally frank about the war-minerals business, which has left so many heartburnings in its wake. He has no doubt in regard to the disingenuous effort of the gentlemen at Washington to restrict claims for compensation to those who were solicited personally by Government officials, ignoring the larger number that were reached by official propaganda in the press. Twice in the course of the interview, Mr. Burch turned the tables on his interrogator, by asking questions himself. That made the performance more natural, for every man likes to retaliate after a while. The interview should appeal to the young men of the West, for it tells how one of them 'made good' and achieved success. Mr. Burch has definite ideas concerning the kind of young man that ought to go into mining as a profession. He specifies the qualifications, but, naturally, he does not stress the special ones that helped him to succeed. One can learn to work hard, to observe accurately, even to think honestly, but the force of character that opens the ways of the world to a true man is not acquired at school or at college. "Which of you by taking thought can add one cubit unto his stature?"

Mr. Sulman and the Medal

The Editor:

Sir—You have referred in recent issues of your journal to Mr. H. L. Sulman's paper published by this Institution in November last and also to the award of the Gold Medal of the Institution to Mr. Sulman. As you appear still to be under some misapprehension as to the terms of the award of the Medal, I am directed by my Council to again inform you that it was awarded to Mr. Sulman "in recognition of his contributions to Metallurgical Science with special reference to his work in the development of Flotation and its application to the recovery of minerals".

The Gold Medal of the Institution is awarded for conspicuous services of a life-long character in the advancement of the science and practice of mining and metallurgy and it is not and has never been awarded for any specific paper as you will see on reference to the list of distinguished recipients in the past, amongst whom are the late Dr. James Douglas, the late Dr. R. W. Raymond, and the late Mr. Hennen Jennings.

C. McDERMID.
Secretary of the Institution of Mining and Metallurgy.

London, July 22.

[We refer to this letter on another page.—EDITOR.]

Mining Near Joplin

The Editor:

Sir—My attention has been called to a news paragraph in your issue of July 17, in which it was stated that "many mining companies, including practically all of the larger producers of zinc and lead in the Tri-State district which centres around Joplin, have agreed upon a plan of curtailment that is expected to force the price of ore to $60 per ton". It would seem from the above that the mine-operators in this district had gone together to restrict output for the sole purpose of increasing the price of their products.

The facts of the situation are that for many months the shortage of freight-cars has caused an accumulation of ore in the bins of the mine-operators. At the present time there is a total of 64,000 tons of zinc concentrate stored in the bins of the district. Every summer the operators are faced with a shortage of labor, due to the requirements for men in the Kansas wheat-fields. This year the crop was unusually large, and it was certain that many of our men would be absent for a profitable vacation, leaving us short-handed. It was therefore decided by the operators to shut-down for a two weeks period, in order to give our men this vacation, and also if possible to permit the shipment of the large accumulation of ore [meaning 'concentrate', probably.—EDITOR] in the bins.

The public at large has not realized that this district has for many months suffered severely from a shortage of freight-cars, and our advices lead us to think there is not much hope for improvement in the immediate future. We cannot continue indefinitely to produce more than we are able to ship, and it has therefore been mandatory for us to adjust our production to our shipping facilities. I would appreciate it if you would correct the wrong impression contained in your issue of July 17, and I assure you that this courtesy will be much appreciated by all of the operators in this district.

EDGAR Z. WALLOWER, Governor,
Tri-State Chapter of American Mining Congress.

Joplin, July 26.

More Books Written in a Hurry

The Editor:

Sir—In the 'Press' of July 10 I discussed what Vernon Kellogg said about Herbert Hoover's work at Broken Hill, Australia; this time I would like briefly to quote a few passages from 'The Making of Herbert Hoover', a biography by Rose Wilder Lane and Charles K. Field in the 'Sunset' magazine for July.

"The big firm of Bewick, Moreing & Co. in London had asked Janin [Louis] to recommend a young American mining man to send to Australia; salary, one thousand pounds a year. Did Mr. Hoover want the job? . . . They write that they have to have a man not more than thirty years old, with seventy-five years experience. A man over thirty can't stand Australian climate and living conditions, they say, and it takes a man of seventy-five to handle their problems down there. . . . He thought it over. . . . It was a great opportunity if he could make good. . . . It was settled . . . He was to leave at once for Australia, by way of London. . . . By midsummer he was buried in work, with plenty to do and precious little time to do it in, it seemed. He had charge of the Coolgardie office of the company [Kalgoorlie is meant, as B., M. & Co. had no office at Coolgardie], the most important office in the colonies. . . . Things were getting in splendid shape. . . . Encouraging compliments were coming constantly from London. Simply the introduction of a little hard work and a lot of American sense. Mining there was in the kindergarten stage of sixty years ago in California. It fairly made an

American engineer weep. Already his introduction of American methods was increasing the output of the mines and threatening trouble with the workmen. He found that the miners were using the old 'double-jack'—one man holding the drill while another struck it with the sledge. It was one of the innumerable small details that he described as sickening. The single-jack was introduced into the mines and he faced a rebellion of the miners. They refused to use the new tools; they flung them into the machinery of the stamp-mills; they were found in shafts and tunnels doggedly working in the old way. . . ."

! !! !!! ? ?? ???

Why discuss such rubbish? and there is more of it too. Shades of eminent Australian mining men rise and smite these biographers, or whatever the writers consider themselves. And shame on the 'Sunset' magazine for widening the distance between America and Australia, instead of making it less, by deprecating Australian efforts, which have given so much to the mining industry.

San Francisco, August 1. MAX VON BERNEWITZ.

[Editorial comment will be found elsewhere.—EDITOR.]

The Status of Gold

The Editor:

Sir—The position of the gold-producers today suggests to my mind that there is something fundamentally wrong that they should consider.

Briefly: Under the gold standard, gold establishes the basis for money credit, but the producers of gold do not get the credit. The producer turns in his gold for about $20 per ounce; that same ounce of gold has a money credit which the banking interests get.

The gold-producers, in my opinion, can correct this situation and come into their own only by forming a 'Gold-Producers Bank', where all production will be deposited. The banking or industrial interests can then obtain the gold by payment of the credit-value for gold, or it may be possible for the Government to issue currency to such a 'Gold-Producers Bank' upon the credit system in operation.

In any event the gold-producers would get what belongs to them rightfully, and the credit they establish would be in their control.

I am advised that there is no law compelling gold-producers to sell their production to the Government.

Reno, Nevada, August 7. F. A. WRIGHT.

Concerning Silver

The Editor:

Sir—Recent communications from Mr. Butters have attracted my attention, and I think a little further publicity is desirable.

It is significant that Mr. Butters seems to agree with the Treasury Department that "silver is cheaper now than it will be in the future". He has suggested something of real benefit to the silver miner, "that the Mint should be willing to exchange silver coin for the bars which the producer deposits". I venture to say that legislation to this effect would be of greater benefit to the whole mining community than the proposed "bonus on gold", as it would stimulate the mining of mixed ores, which have gold only as the metal of relatively lesser value. Our depleted gold reserve would certainly be largely increased if base metals and silver were mined more extensively.

While Mr. Butters does not stand sponsor for bi-metallism, he advocates something which in effect would be of equal value to the silver producer. As a side-light on this phase of the question I would refer to what Mr. Govett said in his speech on the gold problem. "The Indian government embraced the bi-metallic heresy with fine contempt for the economic law that 'it is not possible to fix a ratio between two fluctuating values.' . . . Curiously enough, though entirely unsound, it was good business. For many years it looked as if they were right." This raises the point that it would be "good business" for the United States to take a lesson from the Far East where is our biggest market for silver.

As a query, and for the purpose of provoking further discussion, I would like to ask mine-operators who are producing both gold and silver to consider seriously Mr. Butters suggestion.

FRANK L. SIZER.

San Francisco, August 18.

The Oil-Shale Industry

The Editor:

Sir—I note in your number of August 7, an article by Martin J. Gavin on 'Oil-Shales and Their Economic Importance'. It appears to me that Mr. Gavin has pretty thoroughly damned the enterprise with faint praise. I am interested to note that in his remedies for the coming oil shortage in this country, Mr. Gavin suggests, among others, importing oil from the "enormous potential supplies of Mexico", and the "gradual change in the design of our present internal-combustion motors, enabling them to use lower-grade fuels".

I understand from rather well informed sources that the "enormous potential supplies of Mexico" are not as enormous or as potential as they are cracked up to be; that in fact the territory favorable to drilling so far discovered is very restricted, and that many of the big producers are suddenly going salt. I am also anxious to know where Mr. Gavin is going to obtain his supplies of low-grade fuel even if our present internal-combustion motors are gradually changed for its use. Kerosene and distillate are rapidly becoming matters of history, gas-oil is selling at a high premium in the Middle West, and fuel-oil is crowding gasoline as far as a shortage is concerned.

Continual harping on these two "solutions" grows wearisome. If we have a situation to face, let us at least face it frankly.

DAVID E. DAY.

San Francisco, August 10.

EUREKA, UTAH

Albert Burch: A Western Engineer

An Interview, by T. A. RICKARD

You were born in the West, Mr. Burch?

I was born at Peru, Nebraska, on January 8, 1867.

What was your father's occupation?

Methodist minister.

How did you get your taste for mining?

Through surveying underground. There was no mining in our part of the country. The first mine I saw was the Homestake, in South Dakota, when I was a boy on a railroad survey in 1882.

What was your education?

The equivalent of a high-school training at the State Normal School of Nebraska, followed by one year, when I was 16, in York College in the town of York, also in Nebraska.

What was your first job?

As a boy I worked during the summer on gardens and farms for a few cents per day. My first important job was with the Burlington railroad, in 1880, when on Friday afternoons and Saturdays I made computations on earthwork quantities. The next summer I commenced work for the same people in the field, beginning as back flagman and advancing to chief of a locating party. I remained with them until 1888, when the locomotive engineers strike caused them to cease construction of new lines.

How long were you engaged in railroad work?

Until May 1889.

What led you to your first engagement in mining?

While I was in charge of construction of a branch railroad to the mining camp of Eureka, in the Tintic district, Utah, I was asked by Hank Smith, who was at that time superintendent of the Bullion Beck & Champion mine, to do their underground surveying and make myself generally useful as an outside foreman when there was not enough to keep me busy with the surveying. I stayed there until the latter part of 1891.

What pay did you get?

I got $180 per month, with my room and board. In the middle of 1890 I gave up all the work at the mine except the surveying and the construction of a waterworks system, and took a commission as U. S. Deputy Mineral Surveyor, which proved more profitable. I was married on January 1, 1891, and within a few months it became evident that my wife could not stand the altitude, so I resigned from the Bullion Beck & Champion, and moved to Salt Lake, where I opened an office as Mineral Surveyor late in 1891, but I continued to make periodical trips to the mine for the purpose of keeping up their surveys. On the first day of January 1893, I was offered the superintendency of the mine and remained in charge

until about April 1894, when the property changed hands and I was fired.

What was the reason?

The mine passed into the control of others. There had been a bitter fight for the control of the mine and I was believed to be a partisan of those who had formerly controlled it.

Did you return to Salt Lake?

Yes, and re-opened my office there as Deputy Mineral Surveyor. I also took a lease on the Northern Spy mine, in the Tintic district, which I operated under a lease for a year. This proved to be about the first easy money I ever made. During that year I became interested in the local geology and conceived the idea that a block of ground lying between the old Mammoth mine and the Centennial Eureka ought to contain a considerable quantity of ore. I interested C. E. Loose in the matter of developing it and secured options on the property. Loose carried the enterprise alone for about six months and then incorporated the Grand Central Mining Co. The Grand Central was financed by Loose, the present Senator Smoot, an Ogden lawyer named David Evans, and a hotel proprietor of Provo named Lafayette Holbrook.

How did it pan out?

It proved successful, though nearly all of the original money subscribed, $125,000, was expended before any ore was found. It finally became a profitable mine and it has paid about $1,500,000 in dividends and is still paying dividends. It suffered greatly on account of apex litigation with the Mammoth.

So you had your first taste of apex litigation, Mr. Burch?

I was personally touched by it because the shares which I had valued at $9 declined within a year to about $4, at which price I sold my holdings in the Grand Central, after removing to Wardner, Idaho.

When did you go to Wardner?

In the spring of 1897, but before going there I acted for a few months as substitute manager of a little gold mine in the western part of Oregon. It was owned by an English company—Lawler's Gold Mines, Ltd.—and Mr. Lawler was the manager. He went to Europe in the fall of 1896 for treatment of his eyes and I took his place during his absence. It was while I was manager of this little concern that I first met F. W. Bradley, in February 1897. He came to make an examination of the Lawler mine for some of the shareholders whom he had just met in London. At the conclusion of the examination, he suggested that in case I should want to leave the Lawler mine, he would be in position to offer me the superintendency of the Bunker Hill & Sullivan. He evidently knew that when his report reached London the Lawler mine would no longer be operated and in the course of two or three months this developed. I went to Wardner as superintendent of the Bunker Hill & Sullivan on the first of May, 1897.

Then, you were in charge of the mine at the time of the destruction of the mill at Kellogg?

Yes, I was; and saw the mill blown up.

Looking back, what is your opinion as to the merits of the industrial quarrel in the Coeur d'Alene at that time?

I think that the wages which were being paid by the Bunker Hill & Sullivan just prior to the strike were perhaps too low considering the era of general prosperity that was then beginning. However, before the mill was blown up, the wages of all the Bunker Hill miners were advanced to the figure asked by the Union; but the Bunker Hill company had only a few Union men in its employ. As the total number of employees was 550, and only 90 went out on strike, that represented probably more than the full strength of the Union in the mine, because some men were undoubtedly intimidated. The fight really was for Union control of the district. The Union had been successful in obtaining control of all other mines except the Bunker Hill and had determined to make an example of it. The mill was not blown up by the Bunker Hill employees but by others who came from the outside. I still approve the stand taken by the Bunker Hill management as far back as 1892 against the Western Federation of Miners, who then controlled the Union. I approve their stand for an open shop, which they have continued from that date to this. There was no resistance made by the Bunker Hill officials or employees because the entire county government was in the hands of the Western Federation and resistance of any sort would have meant bloodshed, and prompt prosecution of the resisters rather than the attackers.

You must have your opinion in regard to the bull-pen and other repressive measures that were taken later by the mine-owners assisted by the United States troops.

The action of the State government in rounding up and confining a large percentage of the male population of the county was, perhaps, drastic; but so far as I was able to observe they were well treated, except for confinement. They were detained in buildings constituting what was called a bull-pen because there was not sufficient jail capacity in the county to contain the number under arrest. Most of them were held only during the necessary examination of witnesses before the coroner's jury, which had to determine, if possible, who was responsible for the deaths of three men who were killed. The evidence gained at the inquest was used to a considerable extent later in the trials of those who were indicted, but comparatively few of those who were really guilty were ever brought to trial. On the other hand, a great many who were innocent of any real intent to commit a crime were forced by their officers and the radical element in the Union to join in the attack upon the Bunker Hill property and to the extent that they were innocent participators in that attack they probably had a real grievance against the officers who arrested them and confined them for one week to three or four months in the bull-pen. The point is this, probably two-thirds and perhaps even three-fourths of the members of the local union of

the Western Federation of Miners were opposed to violence, but they were in much the same position as poor dog Tray, who got into bad company, and the officers of the law did not discriminate between those who were willing and those who were unwilling to commit crime.

How long did you remain as superintendent of the Bunker Hill?

Until June 1901, when I was promoted to manager, remaining in that position until January 1, 1903, although I was nominally manager until 1905. Later in 1908 I was appointed consulting engineer to the company with a view especially to the conduct of a litigation in progress with the Federal Mining & Smelting Co. From April 1903 until January 1905 I was a member of the firm of Burbidge & Burch, with offices in Spokane, and engaged in the development of various mining properties under option. My partner was Frederick Burbidge, now living at Wallace, Idaho.

Were you successful in developing anything of importance?

No; so in January 1905 I left Spokane and opened an office in San Francisco, where I have remained up to the present time in practice as consulting engineer.

You were connected personally with the Plymouth Consolidated, were you not?

The properties now owned by the Plymouth Consolidated Gold Mines, Limited, were largely held by the estates of Alvinza Hayward, Walter S. Hobart, and by Charles D. Lane. For some time I had been consulting engineer to the Chicago Exploration Co., headed by J. D. Hubbard. On one of his visits to San Francisco, Mr. Hubbard met Gordon Hall, who was attorney for C. D. Lane, and Mr. Hall talked with Mr. Hubbard about the Plymouth property and persuaded him to ask me to look it over. I did so, and obtained options upon the property owned by the Hayward and Hobart estates, and Lane, and also upon several adjoining properties which I thought should be included. This took three or four months; in the meantime the revolution in Mexico commenced, with the results that the Chicago Exploration Co., which was largely interested down there, decided not to take up new enterprises. This left the Plymouth option on my hands. I tried to interest various parties during the summer of 1911, but was not successful until I met W. J. Loring of Bewick, Moreing & Co. He came to the United States on a visit to his mother. Through his firm, British capital was interested in the development of the Plymouth by means of a corporation called the California Exploration Co. The development period extended from late in 1911 until early in 1914, when the Plymouth Consolidated Gold Mines, Limited, was organized, the control of the shares being taken by the California Exploration Co., the remaining shares going to Mrs. Lane, Mr. Hall, and myself. Since then the mine has been operated continuously and has practically returned its entire cost, namely, $1,000,000, and still has good prospects.

While you were consulting engineer of the Plymouth, you built a club-house at the mine and did other things to promote loyalty among the men. What are your views on welfare work?

Under the head of what is called 'welfare-work' a great many things are done that do not really help to promote good feeling between the management and its employees, because there is frequently a lack of genuine sincerity in the conduct of the work. My own belief is that welfare-work, so-called, is only useful when the head of an enterprise takes a genuine interest in his employees. A man, or a crowd of men, will quickly detect the lack of sincerity, if it is lacking; and that affects anything that can be done to promote cordial relations. Human sympathy must exist between the management and the men, for without it no amount of money expended for club-houses, entertainments, housing, and sanitation can be of real value in promoting cordial relations. It becomes an empty shell without the kernel of genuine feeling.

MR. BURCH AS SURVEYOR AT EUREKA IN 1891

With what companies have you been connected in later years?

In 1911 I was consulting engineer to the Goldfield Consolidated Mines Co., at Goldfield, Nevada, and during the years 1913-1914 I was general manager for the same company.

You must have had experience with ore-stealing, and taken measures to prevent it?

No, I did not. That was before my time. We had difficulty in finding ore rich enough to return a profit after it was handled in the mill, rather than through a custom assay-office.

What would you regard as the most pleasant feature of your management of this mine?

Aiding in the building up of a more cordial feeling between the business-men and townspeople of Goldfield and the management of the mine. It commenced with a dinner to which about 250 people of the town and the more important mine employees were invited. On this occasion a club for better social intercourse between all classes of the community was launched. It aided greatly in establishing more cordial relations between the people of the town and the company. There had been a spirit of suspicion between them, although there was really no reason for it. This reminds me that long before, when I was at Wardner after the strike of 1899, a local union was organized largely on the initiative of Mr. Bradley, and it served as a pattern which I was able to follow in later years at Goldfield and Plymouth. There is no question but that a man's success in life depends largely upon his standing in the community in which he lives and in which he does business, and the same applies to a corporation. Unless the corporation has the good-will of the people in the local community, it will always be subjected to all kinds of annoying and frequently expensive impositions. Whenever there is a spirit of distrust, you have a condition of constant bickering and attempts at gouging, all of which cost real money to the corporation; therefore, either from a standpoint of comfort in living or in actual profits, the corporation can well afford to spend some thought and some money upon maintaining cordial relations between itself and the people in the community in which it operates. It is largely the spirit of the people of Kellogg and Wardner that has maintained industrial peace at the Bunker Hill mine for the last twenty years.

Why did you leave Goldfield?

I was tempted and fell. Mr. Jackling persuaded me to go to Butte in the interests of the Butte & Superior Co., in connection with its litigation with the Elm Orlu. This made it impossible for me to continue my duties at Goldfield.

When did you become consulting engineer for the Mountain Copper Co.?

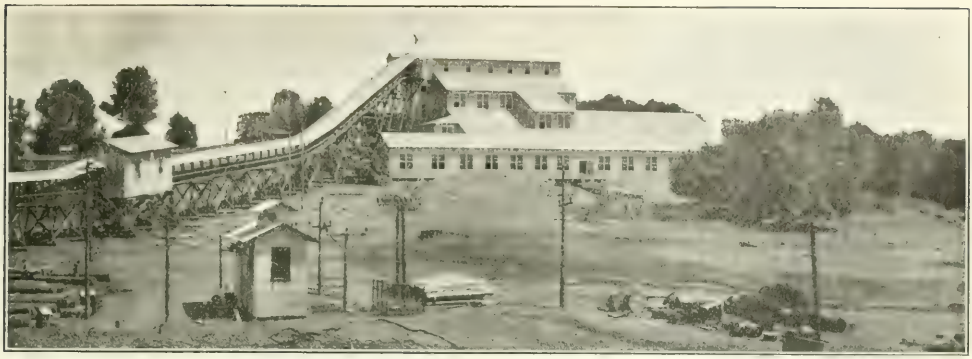
In 1913. Our firm of Burch, Caetani & Hershey became consulting engineers to the Mountain Copper Co. in 1913. Gelasio Caetani was in London early in 1913 and met yourself and through your introduction to then Captain, now Major, Lawson, who was the chairman of the board of directors of the Mountain Copper Co., a connection was established with them in that year. Mr. Caetani, as you know, is an Italian mining engineer, who has specialized in concentration. For instance, he redesigned the Bunker Hill & Sullivan concentrator at Kellogg, Idaho, and designed the mill of the Mountain Copper Co. at Keswick, re-constructed the mill for the Tomboy Gold Mining Co. in Colorado, designed a plant and mill for the Plymouth Consolidated of California, and has acted in a consulting capacity for many concerns interested in the concentration of ores. At the beginning of the World War he returned to Italy and became an officer of engineers in the Italian army. He little expected at that time that he would remain in Italy, but owing to the death of his father and other changes which were brought about by the long-continued war, he finally decided not to return to the United States. Thereby a very valuable man is lost to the profession of mining engineering. The firm of Burch, Caetani & Hershey was organized on the first of January 1912. The third member of the firm being O. H. Hershey, the well-known geologist for the Bunker Hill & Sullivan and other concerns. Since the decision of Mr. Caetani not to return, his place in the firm has been taken by Lloyd C. White.

Looking back, Mr. Burch, over your thirty years of experience, what are the chief changes in mining operations and in the men by whom they are performed?

The introduction of much lighter and more readily adaptable machine-drills is probably the thing that has aided most in bringing down the cost of actual mining operations and also contributed largely to the comfort of the men themselves. The development of electric power and its transmission to all parts of mine-workings has also aided greatly in reduction of cost and in addition to comfort. A study of ventilation in many mines has aided materially. So far as the miners themselves are concerned, I look back to those whom I knew first as a sturdy race of Cornishmen and Irishmen. They have practically disappeared from the larger mining districts, though they and their children, and grandchildren, are found in some of the smaller and older districts of the country, such, for instance, as Grass Valley in California and Central City in Colorado. The miners who succeeded them in the regions with which I was familiar were largely Swedes and Finns. There are still a great many Finns employed in sections of the country, but very few Swedes. Most of the miners now are from south-eastern Europe, and, in my opinion, do not measure up to the standard and type of men that I knew at the mines in my younger days.

To what extent are steps being taken to promote Americanization, and to what extent do you think such steps can be taken successfully?

I am not familiar with the work which is being done by the various Americanization organizations, nor am I in close touch at present with any large operations where individual companies are attempting to carry on a campaign of Americanization. I have no doubt that systematic work of this kind will attain favorable results if sufficiently persistent. I believe that the more we can educate and imbue the foreign element with American ideas and American ways the better it will be for the future of mining, as well as for the country. I also believe that the training of native-born Americans in mining is one of the things that will have to be done in the next few years.



THE PLYMOUTH STAMP-MILL IN AMADOR COUNTY, CALIFORNIA

Have you done anything in the way of night-schools?

I have not. I tried to get some companies interested in private night-school training for the younger employees of the mines. The idea did not meet with a favorable reception, and nothing was accomplished.

You have participated in a good many mining litigations?

Not very many. About half a dozen, but they all happened to be important cases.

May I ask you whether you have any opinion as to the present method of eliciting facts before the Court, and whether you can suggest any better method?

I certainly think that the present method is wrong, because it develops partisanship upon the part of the men who should be studying questions from a strictly scientific standpoint and because of the great waste of money which the method entails upon the litigants. It is a waste of energy and a waste of money and might be avoided by the development of special courts for trying of mining suits. This is not an original suggestion. It is one that I obtained from Judge Farrington of the U. S. District Court of Nevada after the long drawn-out trial of an extra-lateral suit in the court in 1912. He expressed the thought well when he said: "Here I have listened for three months to eminent scientists taking absolutely opposing views upon scientific questions and I as a judge not trained in geology am called upon to decide which group is right." He added: "This is a farce and it could be cured by the establishment of specially trained courts for the disposal of such litigation."

Therefore, you would not approve the retention of present courts with provision that the expert witnesses be engaged by the Court itself?

No, for the obvious reason that the Court would still be left very much in the dark as to the facts because of lack of training upon its part in matters of geology. I do not know whether it would be possible under our system of government to require that cases of this kind be submitted to Boards of Arbitration instead of the present courts, but if this can be done, I would suggest a Board of Arbitration consisting of, say, one lawyer, who had been accustomed to mining practice, one mining geologist, and one mining engineer, and allow the arbitrators to examine the premises and arrive at their own conclusions as to facts.

Thereby rendering it unnecessary to have an array of expensive witnesses?

Yes, that would be the result, and it would also frequently result, I think, in obtaining just decisions or compromises.

You were engaged in stimulating the production of minerals during the War, for the Government, were you not?

I regret to say that I was. I thought it was my patriotic duty to do what I could toward advancing the interests of the nation in connection with the War and did not feel that I could probably be of much service in the Army, and therefore did not attempt to enter the Army, but early in the War made application to Government bureaus for employment in a volunteer capacity. I was accepted as a consulting engineer for the Bureau of Mines and was first sent to Cuba to investigate the manganese and chrome resources of that island. Later, I was placed in charge of the district embracing Oregon, California, and other Western States, with a selected field force for the purpose of examining and reporting upon chrome mines in the territory and advising the operators of the mines to the end that production might be made as rapid as possible. This work occupied practically all my time from the beginning of May, 1918, until after the signing of the Armistice. It then became evident that the industry had been over-stimulated. I have deep sympathy for those who were urged by the various government agencies to begin the production of war minerals as a patriotic duty; but have no sympathy for those who have used this as a cloak to cover exorbitant demands for the reimbursement of funds that were never lost at all.

Do you consider that the decision of the Secretary of the Interior, acting on the advice of the Attorney General, that only the personal solicitations of the Government bureaus should count as proof of work

done in response to the Government was unfair? Do you not think, with me, that the relief given should include all those who responded to the request of the Government as advertised in the press, daily and technical, of the day?

Certainly I agree with you, because a direct personal request was made of comparatively few people and usually the larger and more important operators. The small producer was not approached directly, and yet frequently it is the small producer who has to stand the largest percentage of loss.

How do you regard the question of unionization of mine labor? In other words, is it feasible or practicable to maintain the open shop?

I am a strong believer in the local union, which affords machinery for collective bargaining, the handling of grievances, and a closer approach between the management and its employees without the danger of sympathetic strikes, which are brought on through causes in which the local people can have no interest or knowledge whatever. I do not believe in the salaried business agent, or 'walking delegate', as he was formerly called, who feels that he must stir up trouble and cause turmoil in order to hold his job. I think perhaps if his relationship to the union would change to something like that of the Chinese doctor who is paid a regular fee as long as he keeps his patient well and none while the patient is sick, it might make a great difference in the handling of labor questions between the business agent of the union and the manager of the property.

And you undoubtedly wish the manager of the mine likewise to play the part of the Chinese doctor?

He does now, for he is paid his salary as long as he makes good; when he cannot, he loses his job.

To what extent do you approve of the more modern practice of employing graduates as shift-bosses in mines?

My experience in that has been a little unfortunate. I have employed college graduates as shift-bosses in mines with rather poor success unless the college graduate before, as well as after, entering upon his college career had had a considerable mining practice.

You mean as a working miner?

Yes. The graduate of a mining school who comes from a mining district, was born and reared in a mining district, can usually be depended upon to make a good shift-boss if he has the other necessary qualifications, including physique, but the graduate of a mining school, who is reared in the city, or even in the country districts, where he did not absorb the mining atmosphere, does not as a rule make a good mining man in comparatively subordinate positions. What do you think about it?

Well, Mr. Burch, I think this, that comparatively few young men have the physique as well as the intelligence to do the hard work of the miner preparatory to becoming shift-bosses, and I believe thoroughly that the sort of leader of men that the shift-boss must be is only developed by actual experience in the manual labor that his men are performing. Would you have made a good shift-boss?

I would not, because I had not the practical experience that goes with the duties of a shift-boss, or that leads up to a knowledge of the duties of a shift-boss.

Whereas your experience in surveying and in railroad work did prepare you to become the superintendent of a mine?

It helped.

You have taken a keen interest in the California Metal Producers Association?

Yes, after observing for two years the operation of the Nevada Mine Operators Association, which I assisted to organize, I thought I saw the need for something along similar lines in California. Therefore in 1914 I invited some eight or ten prominent mine operators in California to lunch with me at the Engineers Club, San Francisco, where, after a few hours discussion we commenced the organization of the California Metal Producers Association. This, I believe, has been of value to the mine operators in California. It is now affiliated with the American Mining Congress and embraces within its membership nearly all the large mines and many of the small ones in the State.

What work does it do more particularly?

The first and most important work that it did was to bring about a spirit of harmony between the mine operators and the newly organized California Industrial Accident Commission; it aided in formulating the rules that were promulgated by that Commission in connection with the operation of mines; it supported the Commission in its efforts to reduce rates for workmen's compensation insurance, thereby saving to the operators considerable sums of money. It has maintained an inspection service for the mines of the State for the last three or four years, the Inspector of the Association having at all times harmonious relations with the inspectors of the California Industrial Accident Commission, and in legislative matters it has been of considerable aid to the mining industry in combating vicious measures. These are among the principal things accomplished by the Association, though a great deal of attention has been given to First Aid work and the general improvement of operating conditions about the mines.

You and I, Mr. Burch, had a talk two years ago about the American Mining Congress, and we agreed that it was deserving of support as an agency to represent the mining industry at Washington, and to do for the national industry what your California Metal Producers Association was doing in California. I would like to have your opinion as to the recent extension of the activities of the American Mining Congress in establishing bureaus for statistics and technical information on a somewhat grandiose scale.

I believe that, being in close touch with the various Government bureaus in Washington, it has a field of use-

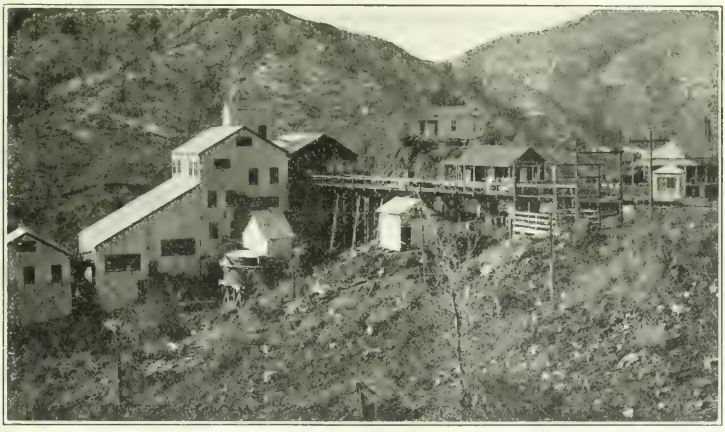
fulness along the lines suggested, in the matter of collecting and disseminating information, not to the public nor to the mining public, but to members of Congress, who are sadly in need of correct information regarding the various measures that come up before that body. The field, you might perhaps consider, is fully occupied by the American Institute of Mining Engineers, scientific and technical publications, the Bureau of Mines, and the Geological Survey; but in my opinion there is still a good field for the activities of the American Mining Congress along the lines stated. It is a fact that can be seen by any one who goes to attend committee hearings in Congress that little attention comparatively is paid to the statements made by the Bureau chiefs and Bureau employees as against statements made by rank outsiders, and since the American Mining Congress makes a specialty of looking after national legislation as it may affect the mining industry, it has to maintain a position

can be kept within bounds it may be worthy of support. What do you think members of Congress really want for their consideration of matters coming before them?

They really want accurate information on various subjects coming from people in whom they have confidence.

Does that mean that they have no confidence in the Bureau of Mines and the Geological Survey?

The experience to be had in the hearings in connection with the War Minerals Control Bill indicates clearly that Congressmen pay but little attention to statements of such eminent men as Van. H. Manning and George Otis Smith as compared with outsiders. The attitude of the average Congressman is that the men in the Government bureaus are trying to get something for the bureaus, whether it is needed for the country or not, and he looks with suspicion on measures which are advocated by these



THE MINNESOTA CONCENTRATOR OF THE MOUNTAIN COPPER CO.

ensuring its officers a respectful hearing. I may mention here that this has been accomplished largely by the efforts of James F. Callbreath. I believe that, if not carried too far, the expansion which has been commenced will be of added benefit. Mr. Callbreath has had to depend in the past largely upon his own ability to collect facts without much assistance and having now the beginning of a corps of assistants he can save his time for more important work. What do you think about it?

I think you have stated the case correctly in the last sentence where you refer to the "more important work". It is a matter of relativity as to whether lobbying—using the word in a kindly sense—and the watching of legislation is not more important than the establishment of further statistical bureaus; but, of course, it may be said that the one cannot be done without the other; that is to say, the stirring of legislation is impossible without an adequate source of data such as the organization can collect for the purpose, so you and I will agree that some of this expansion is warranted and that if it

bureaus. Whether this attitude be right or wrong, that is the attitude of the average Congressman.

Would you advise a young man today to become a mining engineer?

If the young man has the physique necessary to stand a great deal of hardship in all kinds of climate, and also has some of the elements of a diplomat in his make-up, in addition to the technical knowledge which he will gain by taking a mining course, Yes; otherwise, I would say No. There is going to be a continued demand for mining engineers and continued call for young men in minor capacities about the mines and mills. There are a great many more little places, or little positions, than there are big ones; too many of the men who enter upon the profession of a mining engineer get into ruts early in their careers and never seem to be able to extricate themselves. Just why this is, is hard to determine, but sometimes it is because of the difference in ability in different human beings; frequently it is a question of luck, and oftentimes it is due to the lack of diplomacy.

The Knee Lake District in Northern Manitoba

An Official Report

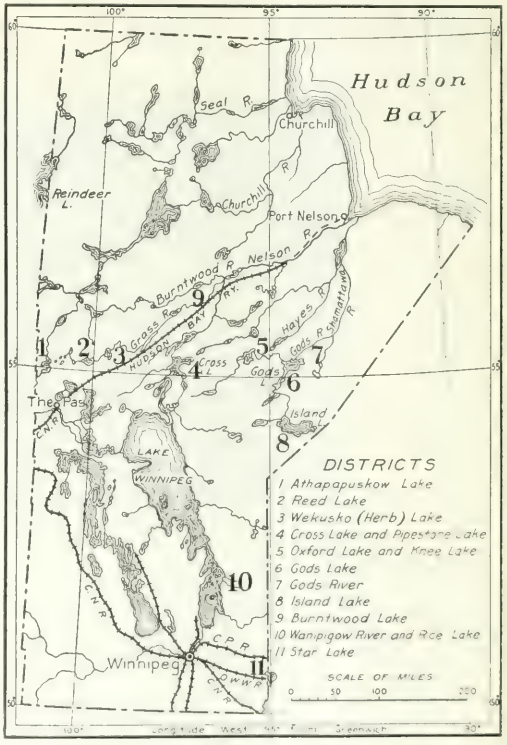
The development of mining in Manitoba has led to some renewed interest in the upper Hayes River basin. Early geologic exploration proved the existence of an area of rocks similar to those associated with the gold and copper ores of the district north of the Saskatchewan river, and a few prospectors paid hurried visits to Oxford and Knee lakes. One party, directed by H. M. Paull of the Pas, staked a number of claims on the north shore of Knee lake and did a considerable amount of development work on them.

The Knee Lake district, in common with other parts of the pre-Cambrian region in Manitoba, is characterized by low relief. In some places the surface is hummocky and rugged, but much of the district is so deeply covered by clay and sand that the solid rocks are not exposed and the inequalities of the solid surface are almost completely smoothed out. Along the shore of the lake, ridges of rock are exposed rising 10 to 30 ft. above the water. Inland the rocks are covered by fine sand and clay and by muskeg, although the elevation may gradually increase up to the divide between the river systems. Thus from points four or five miles from the lake the country appears as a plain sloping gently down to the hollow in which the lake lies. The hollow, however, is considerably deeper than the lake at most places. Hence the solid rocks appear beneath the plan as rugged ridges bordering the lake shore.

The country at the south end of Knee lake is the most rugged part of the region. It is underlain by heterogeneous rocks, the resistant bands of which stand up above the more easily eroded formation. Even in this locality the rock exposures do not extend far inland from the waterways. At the lower end of the lake the country is flat. Outcrops are rare even along the shore, and beaches of sand and boulders extend for long distances, forming a natural levee behind which lie swamps and muskegs.

Hayes river is the only large river in the area examined; very few tributaries large enough for canoe travel join it in the Knee Lake district. A small creek enters the north end of Black lake. It is used as a canoe-route leading to Deer river, which empties into the Hayes a considerable distance below Knee lake. Muskegosip creek drains a lake two miles long into the west end of Knee lake. Wolf river drains Swampy Portage lake and Fisging Eagle lake into the large bay south of Magnetite narrows. Though the volume of water carried by Hayes river is not great, it is the canoe and York boat route to Gods and Island lakes. Below Magnetite narrows, Cinder creek empties into the extreme western bay of the lake. It is the outlet of Cinder lake, a body of water 4 miles long by 1½ miles wide. Many other small streams flow into the lake, but those mentioned are the only ones of any size. The run-off of large areas seems to be accomplished by a slow seepage through the moss and muskeg, without any definite channels.

The fur trade is the oldest and still the most important industry of the Hayes River valley. Much of the country in the immediate vicinity of the river and its lake expansions has been exploited for so long and so intensively that the number of animals taken each year is much



PART OF EASTERN MANITOBA

smaller than formerly, but this is more than offset by the great increase in the value of furs. In the outlying districts tributary to Hayes river, there seems to be no decrease as yet in the number of skins taken.

No systematic examination of the water-powers of Hayes river has yet been made. In the part of the river above Knee lake there are several rapids and falls that could furnish considerable energy. Below Whitewater lake, the first expansion of the river, there is a descent of over 60 ft. in less than a mile of river. The average flow, however, is probably not very large. Below this

is a long narrow part of the river with several rapids; by damming the river below Hellgate rapids, power could be developed from these. Between Oxford and Knee lake several rapids occur and the lowest of these, Trout falls, has almost vertical descent of 15 ft. with possibly an additional 10 ft. in the rapids below. This should develop a fairly large amount of energy.

Much of the area has been burned over and the second-growth trees are still small. In well-drained areas trees attain a fair size, but in the poorly drained areas at some distance from the streams and lakes, growth is very slow and trees seem never to have attained a large size.

The rocks of the Knee Lake district consist of an ancient sedimentary and volcanic complex intruded by quartz-porphyry dikes and by batholiths of granite. These are probably all pre-Cambrian. Pleistocene deposits consisting of till and stratified sand and clay lie directly upon these old rocks, and, over much of the area, are overlain by beds of peat. So much of the region is completely covered by Pleistocene and recent deposits that it is difficult to determine the relations of the pre-Cambrian rocks.

The character and sequence of the rocks of the district are comparable with those in the district in which ore deposits have been found. Little prospecting has yet been done in any part of the Hayes River basin, and the veins found at Knee lake have been disappointing.

The heavy cover of clay and muskeg renders large areas underlain by promising rocks entirely valueless for prospecting. In some parts of the district the solid rocks are well exposed and search may be rewarded by the discovery of mineral deposits, but such parts do not constitute more than 2% of the whole area. Besides this handicap, the district lies at a great distance from transportation routes, and orebodies of only exceptional richness or unusual size would be worth considering. Notwithstanding these drawbacks the country in the vicinity of Knee lake must not be considered unpromising for mining. Some of the quartz veins have been shown to carry gold, although the amount in those examined is too small to be profitably extracted. Much of the area, even when the rocks are well exposed, has not been examined even casually and in those parts of the region as good chances exist of discovering orebodies as in similar rocks in other districts.

Assuming that mineral deposits are associated with igneous emanations, the rocks bordering the small intrusions of granite south-east of Cinder lake and east of the second narrows of Knee lake are the most likely localities for concentration of metallic minerals. Any of the rocks prior to the granite may possibly contain veins, but the brittle massive rocks, such as the lavas, are more likely to contain large and continuous veins than are the soft and heterogeneous sedimentary beds. The quartz veins that have been found to be auriferous occur in fractured quartz-porphyry dikes.

Claims have been staked at two places. One group occupies the eastern end of Magennis island, seven miles from the inlet of the lake, the other group is on a point in Painkiller bay. A few other claims have been staked, but practically all the work done in the district is confined to these two groups. The Lucky Boy, Apex, Mother Lode, and McIntyre claims are located along the same mineralized zone, two claims lying on each side of it. At the eastern end, the zone lies in a dike of quartz-porphyry, but at the western end the dike is north of the quartz zone. In the altered and sheared dike are numerous intersecting veinlets of quartz one inch or less in width. The quartz in the schistose greenstone occurs in lenticular masses, the longer axis parallel to the direction of schistosity. The largest of the lenses uncovered is 25 ft. long and has a maximum width of 12 ft. Some pyrite occurs in the quartz; chalcopyrite is sparingly present in the wall-rocks. No gold is visible and assays of samples across the main lens at its widest part give only 0.09 oz. of gold per ton.

The claims on the point in Painkiller bay are the White Davidson, Tilden Smith, and O'Reilly. The point has been almost completely cleared and many trenches have been dug through the clay overburden. The rocks are greenstone conglomerate with chert and greenstone pebbles intruded by a quartz-porphyry dike. This dike has been fractured and in the fractures veins of quartz up to an inch wide have been deposited. The whole body of the dike was said to carry gold, but assays of samples of the quartz veins that seemed to be the most likely source of the gold show only traces.

GRADUATES from Australian universities will be given the opportunity to obtain a year's practical experience in the plants of the Electrolytic Zinc Co. of Australasia under the supervision of the superintendents of various branches according to the provisions of a plan adopted by the company. Holders of these cadetships, as they are termed, will have an excellent opportunity to gain a full knowledge of the plant in running, of commercial-scale metallurgical operations, and of labor conditions, and will be classified, at the end of the year, as follows: Class A: Specially good men, with personality for command and technical ability. These cadets will be marked for special advancement. Class B: Cadets with technical ability, but without power of command, who may be usefully employed in research. Class C: Cadets with power of command, but without high technical ability might be employed in routine operating. Class D: Remainder to be dispensed with. Cadets may take up either the metallurgical or the engineering side, but no distinct line will be drawn between the two. This scheme is, of course, quite distinct from that for awarding scholarships and bursaries to a limited number of picked university graduates, which has been subscribed to by a number of mining and metallurgical companies in the Commonwealth, including the Electrolytic Zinc Co.

RAISES AND WINZES used for man-ways should have ladders in good repair. Collars of winzes, raises, or man-ways should be protected by means of doors, railings, or bars.

Danger From Explosives Fume in Metal Mining

By D. HARRINGTON and B. W. DYER

*Two recent catastrophes in Western metal mines, in each of which three men were killed by breathing fume from explosives, have aroused keen interest among mining men not only as to the exact cause of such accidents, but also as to the best preventive measures.

In sinking the 45° inclined Marsh shaft near Burke, Idaho, on May 13, 1920, a round of holes containing about 60 lb. of 40% gelatin was blasted by miners on the night shift upon leaving at 11:30 p.m. It was customary for them to leave compressed-air blowers open at the bottom of the shaft until the compressor was shut-down shortly before midnight. Presumably this was not done on this particular night, as the fume was so heavy in the shaft-bottom on the morning of the 14th that at about 8 o'clock, F. L. Bergen, superintendent, and one of the shaft-men, on reaching the bottom, were overcome and fell from the bucket into the sump containing about six feet of water; and when two other men went down in the bucket a few minutes later to investigate, one also fell into the sump and the other was barely able to reach the surface. The three bodies were later recovered from the sump.

At 4:50 p.m., June 10, 1920, at the Dominion mine, Colville, Washington, a round of 11 holes containing about 15 lb. of 60% nitroglycerine was blasted in a 50° raise about 50 ft. above the main-tunnel level by the men going off for the night. In this mine it was the practice not to try to blow out the fume until just before the men on the shift went to work the next morning. Although no work was being done on the night shift, one of the raise-men, curious to ascertain the effect of the shots, at about 7:45 p.m., wandered into the mine (which was a tunnel only a few hundred feet long), and was missed by one of his companions an hour later. When three men tried to remove the body of the inquisitive miner, two of them also were overcome; later these two and the first man were removed from the point at which all were asphyxiated, which was practically at the foot of the raise.

In this case the explosive was ¾-in. straight nitroglycerine, used because the ordinary 1¼-in. gelatin was temporarily unobtainable, though the holes were drilled for the larger sized stick; the explosive, too, was about a year old. While two of the eleven holes missed fire, there was obtainable no evidence of burning explosive, but later, after firing these two missed holes, containing possibly three pounds of the explosive, a sample of air taken a few minutes after blasting, at the point at which the three men had been asphyxiated, gave 0.79% carbon monoxide, or sufficient to cause death after being breathed for a few minutes. It was thought locally that the deaths were due to other gases, but analyses indicate strongly that carbon monoxide was responsible.

These accidents emphasize a danger daily confronting men working in metal mines and especially in small properties. In one case the dangerous fume was in a shaft, in the other in a raise, the deaths in the latter being, however, practically on the tunnel-level. Compressed air was the usual means for removing dangerous gases and in both mines it failed.

In neither case is there evidence of defective explosive or of bad methods of firing; hence the situations are practically such as may occur at any of our operating metal mines, especially those operating on a small basis, and the question arises as to possible prevention of such accidents.

The Bureau of Mines has been asked to attack the problem from various points of view; some companies having several mines and employing hundreds of men have numerous cases of 'powder gassing' annually, frequently with fatal results, and have asked the assistance of the Bureau in finding methods of firing explosives so that no poisonous fume will be developed; others wish experimental work along the line of developing a 'fool-proof' super-safe explosive such that irrespective of method of handling, and conditions, no dangerous fume will result; and still others, realizing the probability that dangerous fume will be generated irrespective of present-day precautions, wish information as to positive methods of removing dangerous fume.

Theoretically, there are in existence today explosives with constituents so balanced chemically that with complete detonation there should be no resultant gases of more potential danger than carbon dioxide, which, mixed with the almost invariably larger quantities of ordinary air present, would be diluted to such an extent as to be harmless. The Bureau of Mines has in several publications given data as to proper methods of blasting, selection of explosives, etc. However, numerous samples of air at faces in metal mines almost invariably reveal the presence of dangerous gases due generally to incomplete combustion, these dangerous gases being usually carbon monoxide and oxides of nitrogen. Dangerous percentages (upward of 1%) of carbon monoxide have been obtained at drift-faces after blasting with explosives of ammonium nitrate as well as gelatine base, detonated with No. 8 as well as with No. 6 caps, fired electrically as well as by fuse, tamped and untamped.

The most dangerous gas found in fume of explosives is carbon monoxide, of which quantities up to and over 1% are frequently found in the general air around newly

*Report of investigations, U. S. Bureau of Mines.

blasted faces, and frequently as much as 0.2 to 0.3% in air from piles of broken rock several hours after blasting. This gas gives headache when mixed with air in proportions as low as 0.05%, and is dangerous at 0.20% and quickly fatal when over 0.50%. Another gas sometimes found is nitrous oxide and its effect, while serious, is not likely to be so quickly fatal as that of carbon monoxide; however when dynamite burns instead of exploding, the nitrous content of surrounding air may be sufficiently high to cause death. Other dangerous gases, such as hydrogen sulphide and sulphur dioxide, may also be found in fume, but are rarely present in harmful proportions. However, straight nitroglycerine dynamite gives off several times as much carbon monoxide gas as gelatin or ammonium-base explosive, hence straight nitroglycerine should never be used in confined places.

It appears that at present there is no explosive used in metal mining, with any guarantee that formation of dangerous gases can be prevented, hence the one feasible preventive is effective ventilation.

It is significant than in 1919, the coal mines of the United States, which are compelled to give minute attention to ventilation, had but three deaths from suffocation from explosives fumes, although over 760,000 men were employed, or about three times as many as in metal mines. Metal mines too frequently place entire reliance on natural ventilation or on compressed air, and both are likely to be inefficient, dangerous, and, in the long run, costly. A compressed-air blower will rarely deliver to a working-face more than 100 to 150 cu. ft. of air per minute. The cost is 2 to 5c. per 1000 cu. ft. and there is danger that at least occasionally the compressed air may, through defective compressing, be charged with dangerous gases. Ordinary ventilation methods by mechanical fans produce air circulation at a cost of about 2 to 5c. per 1000 cu. ft. and, with proper supervision, will readily deliver several thousand cubic feet of air per minute to working-faces, instead of the 100 cu. ft. by compressed-air blowers. For dead-end faces of drifts, cross-cuts, raises, winzes, and shafts, small electrically-driven fans direct-connected to ½ to 10-hp. motors force air through canvas tubing or galvanized pipe, and readily deliver 1000 to 5000 cu. ft. of air per minute, or 10 to 50 times as much air as can be obtained from compressed-air blowers and at much less cost. These small fan and canvas or galvanized-pipe units not only remove fume from the face, but if operated as blowers will keep a stream of moving air at the point where the machine-man or shoveler works. In hot mines especially, the worker's comfort and efficiency are greatly improved and his health and safety assured at least as far as explosives fumes are concerned. Managers of the larger metal mines now recognize this and many new mechanical ventilation units are found in the West.

THE MINING INDUSTRY of Russian Armenia is represented by 22 copper-ore, rock-salt, and pyrite enterprises, 18 of which exploit old mine workings. Seven copper smelters comprise the metallurgical industry of the country. The average annual production during the years 1911, 1912, and 1913 was as follows: 13 mines produced 154,900 metric tons of copper ore; 4 mines 10,000 tons of iron pyrite; 5 mines 25,400 tons of rock salt; and 7 smelters 6614 tons of copper. Armenia's output of rock salt and iron pyrite represents 100% of the production of the whole of Transcaucasia and its production of copper 69%. Before the War Russian Armenia's copper output represented 20% of Russia's total production.

Ozokerite

The largest domestic deposits of ozokerite are in Utah near Colton, Utah county, and Soldier Summit, Wasatch county, along the Denver and Rio Grande railroad, about 90 miles from Salt Lake City. During the War the Soldier Summit deposits were reopened, a new plant installed and production started on an important scale. The ozokeite occurs as a filling of brecciated zones in fissure veins in sandstones and shales. The veins vary in width up to 5 or 6 ft. and the ozokerite in the veins from mere films to 22 in. The ore from the mine is sorted, crushed, and subjected to a refining process. Several methods have been used, varying principally in mechanical details, but the underlying principles are similar. The ore is placed in steam-heated vats with water and raised to a temperature of 54° to 70°C. The wax melts and floats off as a liquid into cooling-vats, while the rock is removed either continuously or intermittently from the bottom. The impure wax is purified by a second boiling, and the tailing from the first tanks is retreated, producing an impure wax which is later purified, a middling product which is returned to the first tanks, and clean tailing which is wasted. The purified wax is heated in an open tank to remove trapped moisture, and then cast or molded into blocks for market.

Ozokerite may be used either as the purified wax or as ceresine, which is made by further refining ozokerite. The wax may be purified by mixing with alkali and filtering through fuller's earth, animal charcoal, or magnesium silicate.

Ozokerite vaseline is made by filtering ozokerite through animal charcoal 12 to 30 times, and distillation with superheated steam at 250°C. for three or four hours. Ozokerite is used for the manufacture of wax figures, dolls, and candles; as a substitute or adulterant for beeswax; as a covering to protect metals from moisture, acids, and alkalies; for making waxed paper; for lining barrels, kegs, and acid tanks; as a foundation for waxes, polishes, liniments, salves, and plasters; for imitation alabaster statuettes and decorations for confections; for artificial honeycombs, for making boot-blacking and polish, varnish, shoemaker's wax, and floor-wax; as a base for a variety of lubricants from axle-grease to gun-oil; in the manufacture of leather polish, sealing-wax, and pomades; and as electrical insulation. A very large and important use, which took most of the domestic output in 1918, was as an acid-proof coating for electrotypers' plates.—U. S. Bureau of Mines.

Care of Rock-Drills

By HOWARD R. DRULLARD

*Best results from hammer-drills may be obtained by giving close attention to two factors in drill maintenance. They are of equal importance; one is lubrication, and the other is care of the shank. With the exception of stoping-drills, most modern rock-drills require both oil and grease. The oil-ports are in the lubricator, on or behind the hammer-cylinder; the grease-port for the lubrication of the chuck-sleeve and rotating mechanism is on the chuck-end. Ordinary machine-oil is not adapted to rock-drills; a heavier more gelatinous oil such as castor machine-oil or liquid grease should be used. The lubricators should be filled once for every 12 or 14 ft. of hole drilled. Grease-guns should be used to fill the port in the chuck-end once a shift; a medium grease is well adapted to this purpose. Hard grease must not be put into the lubricator, as it will not flow through that part. Contrary to the popular belief, oiling a machine once or twice a shift does not provide sufficient lubrication; the drills should be oiled once for every 12 or 14 ft. of hole drilled.

The rotating handle of a stoping-drill is an oil-reservoir and is provided with a port for oiling. The rotating handle is packed with wicking, or similar material, which causes the oil to feed slowly from the handle to the other parts of the machine. Stoping-drills require oil at least twice a shift; lighter oils than castor, such as Arctic Ammonia, may be used.

Drills used in shaft-sinking can be oiled satisfactorily by placing a good-sized drop-sight lubricator on the station above and connecting it with the air-line supplying the sinking-drills. If this lubricator is properly filled and adjusted, a uniform oiling of the sinking-machines will be effected without the necessity of oiling the drills individually. The grease end should be filled at the station or on the surface before each drilling-period. The shift-boss should see that the machines are greased and also that the lubricators at the station function properly. The life of the air-drill hose is somewhat shortened by this method, as oil attacks the inner tube; but as some oil is always present in the compressed air, this is not a serious objection to the method.

When operating wet drills, the water-valve should always be closed before the air is shut off from the machine so that any water leaking from the water-tube will be exhausted from the machine. After drilling is finished, the machines should not be carelessly thrown aside, but should be carried well back from the face and placed in a clean dry place. Many experienced drill-runners stand the drifting and sinking-machines chuck-end up and pour a liberal quantity of oil into the chuck-end. This prevents rusting if there is moisture in the machine; also, the oil finds its way into the small parts, such as the rotating mechanism.

*A paper to be presented at the Lake Superior meeting of the A. I. M. & M. E. in August 1920.

Stoping-drills are often stood in the opposite manner, that is, with the chuck-end down. Oil is then poured around the air-feed piston, often called the 'feed-bar'. The oil flows down the piston into the air-feed cylinder, keeps the cup-leathers soft and pliable and, if the leathers are somewhat worn, passes on into the other parts of the drill.

When machines have been in service for some time without being repaired, they should be sent to the surface to be cleaned and oiled. If this is not practicable, good results can be obtained by pouring 5 or 6 oz. of coal-oil into the air-hose, connecting it to the machine, and then running the drill for a minute or two. This will usually clean a drill quite thoroughly, but care must be taken to keep all lights away from the face for a few moments for, as the oil breaks up into very fine particles as it is exhausted from the machine, it forms an explosive mixture, which has been known to flash and burn the hands and face of the drill-runner. After the machine has been thus cleaned, the lubricators filled, and several ounces of oil poured in the drill-hose, the machine will be found to operate much more freely than before cleaning.

Drill-Shanks

The method of forming drill-shanks on a standard drill-sharpener is simple and quite generally understood. The shanks, however, must be accurately made and maintained at the dimensions specified for the particular steel. A variance of $\frac{1}{4}$ in. in length will often reduce the drilling speed of the machine 25%. Close attention must also be paid to the shape and location of the hole made to accommodate the water-tube. To avoid excessive breakage of water-tubes, this hole must be $\frac{5}{16}$ in. diam. and punched to the depth of at least 3 in. It must be in the centre of the steel and, after punching, should be counterpunched slightly to prevent a sharp edge forming that will cut off the water-tube. The shank, of course, should present a smooth striking-face.

The shank, when properly formed, is hardened. Sometimes this process is not thoroughly understood. The operation is simple, involves no delicate judgment of temperatures or high mechanical skill, can be learned by any intelligent blacksmith in a few moments, and makes a shank that will not batter, break, or damage the piston-hammers of the rock-drills.

The proper treatment of the shank begins in the forging. The steel must not be overheated, that is, it must not approach a white heat. The work of forming the shank should begin as soon as the steel attains a bright-red heat. The steel must not be allowed to 'soak' in the fire, as this causes scaling; an unduly high air-pressure in blowing the forge will also cause the steel to scale, and a scaled shank will not respond properly to the hardening process. After forming, the shanks should be annealed by being cooled gradually; preferably they should be covered with lime or ashes and allowed to cool.

Either fish or linseed oil is satisfactory for hardening, although other light oils are at times used. The quantity required is proportionate to the number of shanks to be hardened at one time; 5 gal. will suffice for the harden-

ing of three or four shanks, but if considerable steel is being worked, 45 or 50 gal. are advisable. A rectangular tank in which the steel can be stood on end conveniently is generally used. A heavy screen should be placed 4 or 5 in. from the bottom in order to hold the steel above any water or dirt that may collect in the bottom of the tank. The oil must be kept free from any foreign matter, particularly water, for water collecting below the oil will over-harden any hot steel that comes into contact with it.

The shank should be heated to a cherry-red at the striking end, with the heat graduated to a dull red just beyond the collars, or lugs; or in the case of the shankless stoping-steel, to a point about 4 in. from the end. The shank is then plunged into the oil and allowed to cool thoroughly; the operation is then finished except for testing.

One thing must be borne in mind: each and every shank must be so hardened that it can be readily cut with a file. The shanks must be softer than the piston-hammers or damage to both will result. It is obvious that if two pieces of steel of approximately the same hardness are brought violently together, one or both will be damaged. If any piece cannot be readily cut with a file, it should be rejected and re-hardened and the oil tested for water. Care must be taken that too many shanks are not treated at one time and the oil overheated; if the oil becomes hot, soft shanks will result. The often-used draw-temper water-method requires an extremely fine knowledge of color values, is seldom accurate, and is much slower than the oil method, therefore it should not be used. If the shanks are properly hardened, any well-made piston-hammer will take care of itself.

Tin, Lead, and Zinc Mining in Great Britain

An interesting report has been made by a committee appointed by the Board of Trade to investigate and report upon the nonferrous mining industry of Great Britain.

The production of black tin from existing mines and streams, all situated in Cornwall and Devon, amounted in 1918 to 6378 tons, which, in terms of metal (the black-tin concentrate from the mines is taken to contain 65% of recoverable metal, that from the stream works 46%) is 3% of the world's production and under 15% of the normal British consumption of the metal, taken at the pre-war figure of 27,500 tons per annum. The falling off in the production during the last 30 years, from close to 1500 tons in 1890, is due to several causes, the chief of which are the fall in the value of the metal in the period 1890-1898, impoverishment with increasing depth, exhaustion, and the increased cost of extraction and of pumping. It was accentuated during the War by the lack of development consequent to the labor shortage.

The future of tin mining in Cornwall depends in a great measure on the finding of new shoots by lateral development on the lodes now worked, or by cross-cutting from existing workings to other known lodes, some of which in their shallower levels were large producers of copper. The work of mining geologists and engineers in the Camborne-Redruth area has indicated the probability that certain mines in this district, which were abandoned when their copper production failed, will be found to be valuable tin producers if developed at a lower level.

Lead mining is of great antiquity in the British Isles, dating back to the time of the Roman occupation; and for many centuries large quantities of lead ore were obtained from outcrops and shallow workings. Deeper mining, involving pumping, belongs to a comparatively late period, but was carried on extensively during the last century. Consequently, the more accessible and richer ore-shoots are now exhausted; and in general it is where natural difficulties hindered exploitation that the richer orebodies have been preserved for the miners of today. A notable example of this is the Halkyn district of Flintshire, where the lodes in the mountain limestone are so heavily watered that they could not be mined to any considerable depth with ordinary pumping appliances. The driving of a drainage tunnel, which was completed about 1886, enabled them to be worked down to 200 ft. above sea-level. A new tunnel has been commenced and would, if continued as projected, unwater the mines down to sea-level, thus rendering a large quantity of valuable lead ore available for mining.

The mining of zinc ore in this country is not so ancient as that of lead mining. The ore is chiefly blende, calamine being of little importance. It occurs associated with galena; but 'black jack', as blende is termed by the miners, was formerly rejected as a waste product, the first recorded production of zinc ore being in 1858. Much has been discovered in recent years by working over old dumps and by re-opening abandoned stopes where blende has been left on the walls of the lodes, or used as filling. The total production, however, is not large, and has fallen from 17,294 tons in 1913 to 9025 tons in 1918, the latter figure representing 5% of the present capacity of the home smelting works. In terms of recoverable metal (the zinc concentrate is taken to contain 35½% of recoverable metal) it represents 0.65% of the world's present production of spelter and about 1.6% of the pre-war British consumption of that metal. The present outlook for zinc mining, the committee states, is discouraging, since mines that are mainly dependent on blende production are not able to make a profit at current prices for the ore. The low price obtainable for home-produced blende is due mainly to the high smelting-costs prevailing, but the purchase by Government of the annual production of the Broken Hill mines of Australia was considered by many to be a contributing cause.

TUNGSTEN is obtained from various ores, such as wolframite, which is a tungstate of iron and manganese, and scheelite, which is a calcium tungstate. Ores are mined in Colorado, California, New Mexico, and in other places. The ore is usually reduced to the oxide, which is a yellow powder.

Standardization of Mine Work

*The application of time-studies to mining operations on any comprehensive scale, I believe, is new. The value of time-studies was first emphasized some years ago by Taylor and has been widely recognized in manufacturing and other productive industries, but aside from special cases has never been used in controlling or standardizing underground work. All time-studies at North Butte were made by the company's staff. The well-known methods in general use in manufacturing industries were employed, but it was considered best to have the actual work done by men of experience in metal mining and familiar with the particular underground conditions to be studied. The investigations were comprehensive. Every operation underground was timed and a careful record was kept of the figures. The data, which were quite voluminous, after critical analysis by Mr. Braly and his assistants, formed the basis of the standard of efficiency ratings now in use. The time-studies also suggested numerous improvements whereby individual work could be made more productive with little or no increased effort. A classification of underground labor into various kinds of work performed under present conditions is as follows: Miners, 15.7%; shovelers, 26.8%; trammers, 18.9%; timbering, 26.4%; powder-men, 2.3%; nippers, 2.1%; station-tenders, 1.8%; shaft repairs and shaftmen, 2.4%; draining and ventilation, 1.9%; top carmen, 1.3%.

The greatest difficulty in applying the results of these time-studies to actual operations was to find a simple method of recording the work of each individual workman. This was finally solved by the 'pictorial' record card devised by Mr. Braly. On this card, the letter A, for instance, represents setting up a machine and taking it down, including bringing up the machine from the drill-platform to the breast, bringing the column to the breast and setting it up, placing the machine in proper position, connecting both air and water-hose, oiling the machine, etc., all preparatory to drilling. Should the time-studies show that the proper time for two men to perform this is 40 min., if they perform it in 50 min. they are 80% efficient; if they perform it in 30 min. their efficiency would be 133%. Every operation in drifting and cross-cutting has been timed and is known, so that it is only necessary to record the operations done by any man underground for an entire day, add them together, and compare the totals with the standard in order to arrive at his efficiency for the day. Shoveling, tramming, timbering, and all other underground work were timed in the same careful and detailed manner.

In practice, the shift-boss makes out cards daily for the men in his crew and sends them to the office, where the factors are applied. The cards for each man are totaled weekly and the factors have been so worked that the units can be added directly on a machine without involving any excessive amount of clerical detail.

These cards are not only efficiency records, they are instruction cards for the men and the shift-bosses. They also give the shift-bosses specific information as to what men in different positions ought to do; this is one of the most important results that has developed by the use of this system. Many shift-bosses are inclined to give some men too much work and not enough to others, not intentionally, but because they have not crystallized in their minds the exact amount of work a man should do. Further, there is recorded on the cards the supplies used each day in each working-face. This facilitates compiling; and it has been found possible to improve considerably the routing of supplies to points of use, and thus eliminate time lost because the men did not have their supplies within convenient distance. Stocks and the location of underground supplies are kept track of on tally-boards, on which supplies used each day are pegged up from the cards; the stocks are replenished without special requisitions from shift-bosses. Tally-boards are also used for compiling the output of ore and waste-rock shoveled, and other items of work done.

After having established the time-standards and installed the system of recording individual efficiency, a bonus-system was inaugurated under which underground men are paid a bonus based on efficiency rating in excess of 80% of the standard. All underground men are paid the standard rate of day's pay regardless of rating, but if they make a rating of over 80%, they are paid at fixed rates per point above 80%. This is an incentive for the men to study their jobs and co-operate in raising the efficiency of the whole organization. However, the primary object of standardizing the work is to educate the miner to conserve his effort and not waste it. Ordinarily it requires much less energy to do a thing right than to do it wrong, and the application of the standardized methods has demonstrated this. The standard methods introduced have resulted in increased efficiency, but it is believed that they have at the same time enabled the workmen to do their work more easily.

It was also found that inefficiency was frequently due to men not being placed to the best advantage. For nearly three years, employment has been in charge of the assistant superintendent instead of the individual shift-bosses. He interviews all applicants for work and furnishes the various shift-bosses, on their requisition, with such numbers of men as they require. Men who are recommended for discharge or who wish to leave are obliged to report to him; in many cases such men are transferred and retained as employees. Of men so transferred, about two-thirds have made good in their new jobs. Since establishing this system, labor turn-over has been reduced over one-half and the shift-bosses have found that they get a much better force of men than when they hired their men by selecting from those who applied each day. The policy does not contemplate or tolerate discrimination against any man who is, by no fault of his own, unable to make a high rating; the policy is to give any man who is willing to work a chance to do so, to place him where he can do his best, and to educate him in his work so that he can do it better.

*From a paper presented by Robert Linton at the Lake Superior meeting of the A. I. M. & M. E. in August 1920.

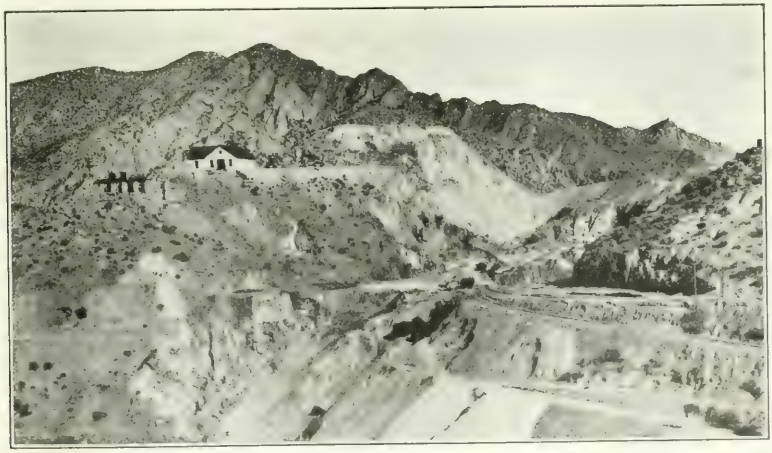
REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

ASBESTOS MINING IN THE GLOBE DISTRICT.

GLOBE.—October 10 to 16 has been designated as 'safety week' in the Globe-Miami district, according to a recent announcement. Special plans have been formulated and the goal has been set for a week without a single 'lost-time' accident. The cutting by the Old Dominion company of the Maggie vein on the nineteenth level is considered important. The vein is practically undeveloped and it has recently been found that the ore assays better than 5% and is therefore available for direct smelting. Operations are to be continued down to the twentieth level in order to secure drainage. The San Carlos Indian reservation is to be opened at once for prospecting. The western section is known to be especially rich in asbestos, generally found in localities so rough that aeroplanes or dirigibles have been suggested as means of bringing out the ore. It is reported that Arizona will produce this year as much asbestos as the total output of the United States last year. During the year 1919 the total quantity of asbestos sold in the United States was 1002 tons, nearly half of this amount being contributed by Arizona. Almost all the asbestos mined in Arizona comes from the region north and west of Globe, although promising deposits have been found in the vicinity of Grand canyon. Members of the U. S. Geological Survey have found valuable deposits of asbestos on the Fort Apache Indian reservation and also the San Carlos reservation. Although mining is not yet permitted on these lands, the Government is taking steps to have these deposits made available to meet an ever-increasing demand for the product. T. R. Drummond, president of the Superior & Boston Mining Co., together with several associates, recently had a narrow escape when visiting properties in the Dripping Springs valley. While driving through the sandy bed of a wash, where travel is rarely impeded, they were overtaken by a cloudburst which lifted the Ford car in which they were traveling, and carried it along at rapid speed for nearly a mile, finally leaving the party stranded high and dry on a welcome bar. After pumping out the machine it was found possible to resume the homeward journey without assistance.



LONGFELLOW MINE OF THE ARIZONA COPPER CO. AT MORENCI

JEROME.—It is reported that Tom Collins and associates are prospecting the Verde Central group of claims, having a large tract of land under option. Mr. Collins, who is an expert miner, was instrumental in collecting the group of claims which originally comprised the Junction division of the Calumet & Arizona Mining Co., in the Bisbee district, and which forms one of the best portions of the property of this organization, and he hopes to be as successful in his development of the Verde Central group. It is announced that sinking will shortly

be resumed at the Dundee-Arizona, perhaps as soon as the first of September. It is believed that the country has been drained to such an extent that the company will no longer be troubled greatly by the flow of water which forced the suspension of sinking last winter, when the shaft had reached a depth of 810 ft. When the pumps were stopped the water rose to within 25 ft. of the main station on the 450-ft. level. In the last two months it has subsided fully 150 ft. Development of the Dundee's surface deposit of carbonate ore continues. As yet no decision has been reached regarding the character of the plant that is eventually to be installed to handle this ore.

BISBEE.—It is reported that the old Mellegren property at Tombstone has been purchased by Frank P. Cavanaugh, a mining engineer of New York, representing a new company which has been incorporated in the name of the Tombstone Silverfield Syndicate, and announcement has been made that mining operations with modern machinery will begin shortly. After 30 days of preparation, the Flux Mining Co. started operating the mill at its property at Patagonia last week. For the present the company will work on a high-grade lead-silver sulphide ore of which about 300 tons has been broken down ready to mill. Many more tons are reported in sight. Although the mill has not been in operation long enough to give accurate figures, the company estimates that it will be able to mill 30 tons per day with one shift operating the mill. This is expected to make about eight tons of concentrate to be shipped to El Paso for smelting.

JEROME.—Owing to the failure of the stockholders to respond to the proposal made by the directors that they subscribe to a bond-issue for the purpose of continuing the development of the property, the Jerome-Verde is being closed down. The pumps are being pulled, the mules hoisted to the surface, and all preparations made for a period of inactivity at the property.

COLORADO

RICH ORE FOUND NEAR GEORGETOWN.

ASPEN.—Electric power is to be substituted for steam at the power-plant at the portal of the Hope tunnel of the Hope M. M. & L. Co. and a contract has been signed with the Roaring Fork Electric Light & Power Co. A saving will be effected, as the haulage charge on coal will be avoided. The breast of the Hope tunnel is in the blue and brown lime formation containing some silver, lead, and zinc.

GEORGETOWN.—Tetrahedrite ore sampling 400 to 2220 oz. silver per ton has been opened up in a new shaft on the Ready Cash in the Williams Fork section at a depth of about 30 ft. by Teagarden and Taylor, well-known Georgetown miners. The operators are sacking ore to be packed on burros and plan the installation of a steam-hoist. The Silver Mountain mine, operated by the Nelson Leasing Co., is producing both smelting and milling ores. A force of men is remodeling the Payne mill at Empire and a flotation unit is to be added. The American Vanadium Corporation has a force of men preparing for resumption of work on the Urad molybdenum group that it acquired from the Primos Chemical Company.

IDAHO SPRINGS.—The Gem Mining Co. has surveyed a route from the Frater Friend group to the Silver Age mill-site on the C. & S. road below the city, and a tram will be constructed for the delivery of ore to the modern mill that will be constructed. The Crown Prince company has miners employed in the Hecla tunnel. Sulphide ore containing gold is being developed. The Hireen Mining Co. has awarded a contract for 600 ft. of cross-cutting and drifting at the Lake property. The lateral will connect with the Frontenac workings and ventilate both properties. Cabins are under construction on Mount Kelso for the miners employed on the Decker-Jeffrey properties. The tunnel has cut a vein, 600 ft. from the portal, that carries smelting and milling ore. Operations are to be continued through the winter.

SILVERTON.—The Climax-Tip Top tunnel in Eureka gulch is being re-timbered and re-tracked and development resumed. The property owned by the Brensen estate has produced high-grade gold ore. New York interests plan development of the Ariadne and the management is now cross-cutting at the fourth level for the shoot opened on the three levels above. A winze sunk from the third level proved continuity of the ore, with a streak 14 in. wide sampling 1 oz. gold, 51 oz. silver, with some copper content.

DENVER.—John T. Burns, assistant secretary of the American Mining Congress, now here to arrange for the September meeting, is authority for the statement that a Standardization Conference will be held in Chicago on August 30, at which Charles A. Mitke, chairman of the Metals section of the Mining Congress, William R. Roberts, president of Roberts & Sheafor, construction engineers, chairman of the Coal section, and representatives of the Federal Bureau of Mines, National Committee on Standards, and the American Institute of Mining & Metallurgical Engineers will be present. Details of the proposed work will be arranged. The Standardization conference will, it is expected, occupy two or more days of the 23rd annual convention of the American Mining Congress to be held in this city in November.

MICHIGAN

FURTHER DECLINE IN COPPER PRODUCTION.

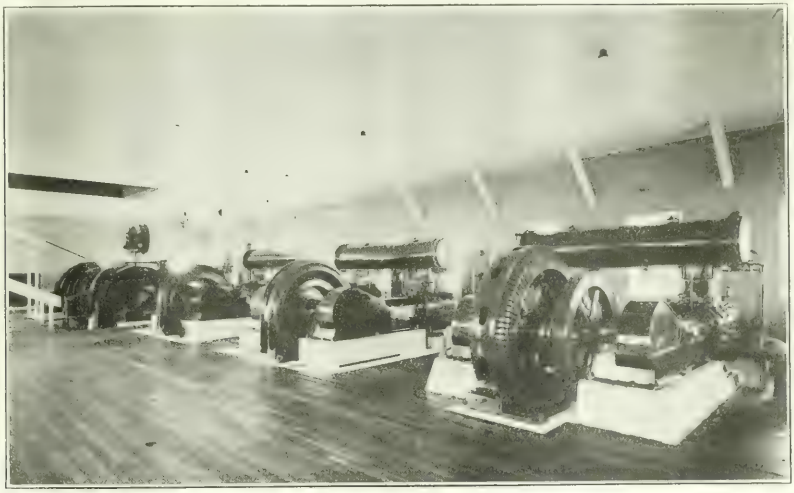
CALUMET.—A decrease of 710,854 lb. of refined copper is noted in the July production report of Calumet & Hecla subsidiaries. Total output was 8,312,025 lb., compared with 9,022,879 in June and 8,803,811 in May. Production for July follows: Ahmeek, 1,572,838; Allouez, 262,400; Calumet & Hecla, 4,684,972; Centennial, 34,600; Isle Royale, 775,200; Osceola, 735,900; Superior, 85,800; White Pine, 160,315. Of the Calumet product, 1,168,093 lb. represents the output of the reclamation plant. Osceola and Superior are the only mines of the group to show an increase over June, when the former

produced 661,500 lb. and the latter reported an output of 32,200 pounds.

Copper continues to go out from the Lake region in small lots, practically all of which is being shipped eastward. Calumet & Hecla this week filled an order for 250 tons for a New England customer and 350 tons of ingot bars also went out for a Philadelphia firm. Only small amounts of Calumet copper are going to automotive concerns. Quincy and Copper Range are filling frequent orders from automobile plants but the sales are far below normal. The lull in export trade is indicated by the fact that no metal has been shipped to Great Britain for several months. Only one shipment has been made by Calumet to Germany this year and the only order of consequence for some months is that now being filled for France, consisting of slightly over 1500 tons.

Colony still is in vein matter, but for the past few days probably not in commercial 'rock'. Nevertheless the work is of value, as it establishes the dip of the formation. The south drift, which now terminates 150 ft. from the shaft, is in trappy ground and the east cross-cut continues in the conglomerate. It is the plan of the management to proceed with the cross-cut, carrying out original exploration plans, but another week or ten days may bring it into a new formation.

With the first indication of the restoration of former conditions in the metal-market, Wolverine will begin to develop and explore the several lodes that are found in its property east of the Kearsarge formation. Two or three veins, penetrated by diamond-drills and cross-cuts from various levels below the 14th, yielded ore in commercial quantities and the preliminary openings were



COMPRESSORS IN THE NEW ENGINE-HOUSE OF THE TONOPAH EXTENSION MINING CO.

Local companies do not expect much improvement in the market until foreign demand improves.

Mohawk's experiment with 'zinc-field' scrapers in its levels have been disappointing and until a device that is less cumbersome is perfected no further attempt to utilize it will be made. The employment of stope-scrapers, however, is a splendid success and they are a permanent fixture in the Mohawk and Wolverine mines. They are operated by two men and perform the work that four to six men formerly did by hand shoveling. Mohawk's openings keep abreast of those of a year ago, while the yield continues at 22 or 23 lb., with occasional shipments of 'mass' boosting the grade to 25 lb. or better. With the present small force, compared with that employed in past years, no attempt is being made to open the fissure in No. 4 shaft and this will be left for future years. This vein, originally opened on the 22nd level, south, of the No. 4, contains considerable 'mass' and warrants extensive work as soon as conditions permit.

The raise in the west cross-cut of Mayflower-Old

of such character that extensive work on them will be done just as soon as the step is warranted. The showing in an amygdaloid on the 28th level was particularly promising and it is probable that the first development work will be on that lode. There will be no let-up in operations on the Kearsarge vein and by the time all of the arches and backs are removed it is expected reserves in other parts of the mine will have been determined. In the event the showing fulfills predictions, Wolverine's life will be prolonged. It was with the intention of developing new ground that the management decided that the shaft-pillars would not be removed, so as to keep the shafts intact. The pillars contain thousands of tons of high-grade rock, for they are 90 ft. square, extending to the bottom levels from the surface.

While Pine Copper is preparing to suspend operations and at present only a few men remain on the property. This decision came as no surprise, for the constantly rising costs of labor and supplies, together with the steady decline in output, left no alternative. For the

past four or five months a force of only 150 men has been employed and production dropped from 285,000 lb. in March to 160,077 in June. White Pine is a mine that presents different problems and requires more modern methods than any other property in the district. Due to the fine character of the copper in the Nonesuch lode, flotation and re-grinding have been used successfully. The rock is low in grade, in fact so low that it is stated that the mine can operate successfully only on a quantity basis. It is a subsidiary of Calumet & Hecla.

NEVADA

RECO DIVIDE CO. IS PROSPECTING NEAR WINNEMUCCA.

PARADISE.—The Reco Divide is prospecting 17 claims adjoining the old Spring City mine that were acquired by location. A shaft has been sunk 35 ft. in a quartz vein 10 to 40 ft. wide, and small seams of ore assaying 40 to 50 oz. silver and 40c. in gold have been found. The Reco first had an option on the Spring City, in which there was said to be good ore under water. The Spring City has a production record of $3,000,000 net, made in the early '80s, but the ore-under-water rumors were scouted by J. B. Kendall, president and manager of the Reco, and work was stopped after one carload of ore had been shipped through Winnemucca, 50 miles distant. Kendall, formerly mine superintendent for the Goldfield Consolidated, said all he had ever found under water was fish. He estiamtes that a 1000-ft. tunnel driven in quartz with hand-steel by the Spring City in the '80s cost $150 per foot. The ore was hauled to Martin creek, 12 miles distant, and milled. It now costs $23 per ton to haul supplies from Winnemucca. Kendall has a good opinion of the district. The formation at Paradise is porphyry and slate. The Reco is developing a gold prospect at Spanish Flat, 20 miles from Kirby, a station on the Southern Pacific in Humboldt county. A 50-ft. tunnel is being driven to cut at a depth of 60 ft. a vein in which rich ore was found on the surface. The formation is lime shale, and Kendall has little confidence in the district. The Reco is backed by New York men for whom Kendall is trying to find a promising prospect.

ALLIED.—The Allied Mining & Milling Co. has at the mine machinery for a concentrator that is expected to treat 40 to 50 tons of lead-silver ore daily. The wagons in which the machinery was hauled returned to Goldfield loaded with 45 tons of ore assaying 60% lead and 15 oz. silver, according to David Trepp, manager. The construction of the plant is in charge of George S. Wardell, formerly mine superintendent for the Alto and East Divide companies. The manager says that conditions are excellent and that a raise from the 110-ft., or second level, has been driven to the surface in ore 4 to 15 ft. wide and assaying $40 for this width. This shoot has been opened for 100 ft. on the second level, according to Trepp.

MANHATTAN.—A 150-ft. winze is to be sunk from the 800-ft., or bottom level, of the White Caps to determine the position and condition of the ore-shoot before sinking of the shaft to 1000 ft. is started.

SPANISH BELT.—A five-mile electric-power line has been completed to the Spanish Belt and it is expected to have a 50-ton mill and an electrically-driven air-compressor working within six weeks, according to Jules V. Barnd, president of the company. The mill will be built at the main tunnel, which is to be continued 150 ft. to connect with the shaft-workings.

GOLDFIELD.—The winze from the 910-ft. level of the Spearhead has been sunk 170 ft. and it is being continued. From the 130-ft. point it has been in the footwall of the vein and at the present depth seams 18 in. wide and assaying 80c. in gold are being cut. The last assays taken in the vein, at 130 ft., gave a return of $7.90 for a width of eight feet.

WEST DIVIDE.—The raise from the tunnel level of the West Divide is 40 ft. high. At the 65-ft. point a crosscut will be driven to the vein, according to L. L. Patrick, manager. The Occident Divide, owning eight claims adjoining the West Divide on the south-west, has started selling stock to raise funds for sinking a shaft. There is exposed in a 70-ft. inclined shaft sunk by former owners an 18-in. seam of ore that assays 80 to 120 oz. silver. The officers of the company are R. S. Wilbur, superintendent of the Spearhead in Goldfield, president; F. E. Sholtz, one of those who sold the Bell claims at Quartz mountain, vice-president; R. T. Armstrong, secretary and treasurer. H. F. Bruce, formerly manager for the Kernick companies at Divide, is a director and is consulting engineer.

TULE CANYON.—The cross-cut on the 200-ft., or bottom level, of the Ingalls has been driven 25 of 70 ft. necessary to reach the vein. The work is being done under contract with machine-drills and the cross-cut is being advanced 4 ft. daily. Whether the sale will be concluded depends on what is found at this depth.

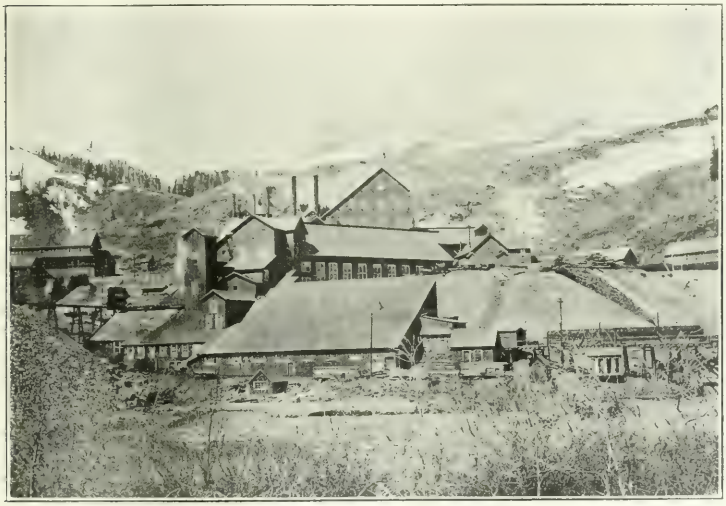
UTAH

MINING COMPANIES PROTEST INCREASE IN FREIGHT-RATES.

SALT LAKE CITY.—A protest on behalf of the metal-mining companies against an increase in freight-rates, especially on low-grade ores, was begun on August 20 before the Public Utilities Commission. H. W. Prickett, manager of the traffic bureau of Utah, introducing witnesses to show that if such raises are permitted, it may put many low-grade ore shippers out of business. A. G. Mackenzie, secretary of the Utah chapter of the American Mining Congress, explained that freight-rates have a great deal to do with mining costs, as Utah is a low-grade-ore State. Testimony was given showing that an increase in freight-rates is a double burden to the mines, as the rate itself is not only raised, but the smelters also increase their rates, as a result of the increased cost of coal, limerock, and other supplies. After the freight increase on June 25, 1918, Mr. Mackenzie stated that the smelters raised their rates on smelting ores from 50c. to $1 per ton. Figures were presented, showing that in 1917, there was mined in the State 15,358,481 tons of ore; in 1918, 14,705,718 tons; and in 1919 about 6,427,000 tons, the decrease being attributed to the mounting costs

of production and adverse metal markets. The values of the above tonnages were given at $99,328,155 for 1917, $86,047,597 for 1918, and $45,438,985 for 1919. Mr. Mackenzie further stated that as a result of the adverse conditions, many Utah mines had been forced to ship high-grade ores, either avoiding the mining of low-grade ore, or throwing it upon the dump; that 138 small producers, who shipped a total of 1,058,244 tons in 1918, had been compelled to suspend shipments on account of the increase allowed in June of that year. All witnesses examined were agreed on the fact that any advance in freight-rates would be an unjust burden on mine operators, especially upon those who ship low-grade ores, and would undoubtedly result in the closing of many of the smaller properties.

GOLD HILL.—The Western Utah Copper Co. has entered into a new contract with the American Smelting & Refining Co., which will permit the production of its mine to be increased to three times the present output. During July the company shipped about 3000 tons of lead ore, and new contract calling for an output of 300 tons per day. It is estimated that there has been developed about 150,000 tons of low-grade lead-silver ore. All of this tonnage is above the 750-ft. level, the deepest in the mine. In addition to the lead ore, there is a large tonnage of iron fluxing-ore developed, and a low-grade copper-ore deposit.



DALY-WEST MINE AT PARK CITY, UTAH

EUREKA.—The Tintic Milling Co.'s plant is not operating at capacity on account of shortage of ore, an average of only about 150 tons being treated daily. One shift is employed in the crushing-department, while three shifts are required in the leaching and roasting-departments. At present some changes are being made in the precipitating and refining sections of the plant which will make it possible to separate the gold and silver from the copper, and thereby enable the company to sell the gold and silver direct to the mints. Recently a shipment of 30 tons of bullion was made to an Eastern refinery.

Exploration work being conducted at the Emerald mine, adjoining the Mammoth, the Centennial-Eureka, and the Grand Central properties, is meeting with encouraging results, according to officials. Development is being done on the 1000-ft. level, at which depth it is the intention to open up the north-south break which has been so productive in the Eagle & Blue Bell and Grand Central properties. This break can be traced, it is said, for a distance of 1500 ft. on the 'Diamond' claim. On the western side of the property, the ore-zone which has been productive in the Centennial-Eureka mine, can be traced across the Emerald ground for 3000 feet.

Development work is going ahead in a satisfactory manner at the Tintic Paymaster property in the northern part of the district. At the present time, a station is being cut on the 350-ft. level, preparatory to sinking a winze from the east drift, which is in a distance of about 500 ft. This winze is being sunk for the purpose of following a small vein. At the Selma Mines property, which adjoins the Tintic Paymaster on the south, work has been resumed and two shifts are employed in sinking the shaft, which now has a depth of 250 ft. At the Eureka Bullion property, small bunches of ore in the north drift on the 800-ft. level have been found, and a winze is sunk for further exploratory work. Within the next 30 or 40 ft. is is expected to be able to determine the extent of the showing. John M. Bestelmeyer, manager for the company, states that the shaft is now at a depth of 900 ft., and a winze has been sunk from the 900-ft. level to a depth of over 400 ft. Within the next month, sinking of the winze will be resumed.

PARK CITY.—An important find has been made at the property of the Keystone Mining Co., according to Andrew Hurley, superintendent. The new orebody is on the K. K. Level No. 3, and since the vein was broken into, a drift 20 ft. long and a cross-cut of the same distance have been driven, all in ore averaging $75 per ton. Another network of mineralized fissures has been cut by the Spiro tunnel, being driven by the Silver King Consolidated to develop its holdings at depth. The fissures heretofore penetrated by the tunnel have been cross-cut almost at right-angles. The newer veins are coming in obliquely, with a south-west trend. The territory now being pierced by the Spiro tunnel adjoins that of the Silver King Coalition company.

BRITISH COLUMBIA

EMMA MINE AT NELSON IS AGAIN PRODUCING.

HAZELTON.—Encouragement of the production of gold is a problem which is giving the Provincial Mines Department some concern. The amendments to the Placer Mining Act passed at the last session of the Legislature reducing rentals and other expenses attached to leases, and permitting the payment of arrears annually in comparatively small amounts, were aimed to making it easy for those really desirous to operate, and at the same time squeezing out those who have been holding merely for speculation. Attention now is being turned to a more direct, and perhaps a more practical, form of aid. J. D. Galloway, resident engineer with headquarters at Hazelton, has been authorized to continue Keystone-drilling operations on the placer areas at Harpers camp. This work was started last year, but for various reasons could not be finished. An expert crew of men has been engaged and operations have been under way for some weeks. Mr. Galloway estimates the amount of gold taken out of this area at from $500,000 to $1,250,000. It is pointed out that the character of the gold taken from the ground was uniformly 'fine, flat, and well worn', making it clear that it had traveled some distance and probably had its origin at some unknown point far up the Horsefly river.

TRAIL.—Four smelter employees were seriously hurt recently while at work in the copper-refinery of the Consolidated Mining & Smelting Co. All were burned about the face, and one, Gordon O'Connor, may not recover his sight. Molten copper splashed between the molds and into running water used for catching the drip. The copper was shot 40 ft. into the air. Ore receipts at the Trail smelter of the Consolidated Mining Co. for the week July 21 to 31 aggregated 12,862 tons and for the week August 1 to 7, 10,221 tons.

NELSON.—The Emma mine of the Consolidated Mining & Smelting Co. will resume operations immediately with a force of 50 men. This property formerly shipped about six cars of ore per week, but work ceased last year when production was discontinued at the Rossland mines. Now that the latter have resumed, the ore of the Emma is required, as it makes a good flux for the product of Rossland. It is understood that its output will be about the same as before. The ore is low-grade gold, silver, and copper.

VANCOUVER.—The Liberator Mining Co. has been formed to take over and operate the Emancipation mine, situated on the western slope of Coquihalla valley, opposite Dewdney creek. The consideration is $60,000 in cash and $100,000 in shares. In the Canadian Geological Survey report, which recently has been published, Charles Camsell, deputy-minister of mines, describes this property as follows: "The first work on this property was on a big quartz vein carrying a little gold. Later work, however, was confined to a high-grade vein near the hanging wall of the larger vein. On this a tunnel has been driven 220 ft., with a cross-cut 80 ft. in length to the right at a point 70 ft. from the portal. A raise to the surface and a winze 50 ft. deep were made on the ore-shoot. The raise and winze supplied all the ore shipped, namely, 90 tons, which yielded $35,000. The vein carries pyrite and arsenopyrite, some enargite, and much free gold. The gold is associated with both minerals and with them impregnates the country rock adjacent to the vein. Polished specimens indicate that the gold was introduced later than the pyrite and arsenopyrite."

SLOCAN.—Lessees on the No. 3 level of the Rambler-Cariboo mine have struck a one-foot vein of practically clean galena, assaying 71% lead and 370 oz. silver per ton. The discovery was made 450 ft. below the outcrop, with virgin ground above, so if the vein holds in size and richness the men have a bonanza.

ONTARIO

ONTARIO MINING ASSOCIATION MEETS AT SUDBURY.

COBALT.—Favorable developments in the Gowganda, South Lorrain, and Elk Lake districts, are reported, while at Cobalt the result of work on some of the newly-opened properties is also adding to the number of producers. At the 350-ft. level of the Bailey Silver mines a shoot of high-grade ore has been cut in which the silver content ranges from 2000 to 4000 oz. per ton. Further work will be necessary before the extent of the ore-shoot can be determined. The Keeley Silver Mines in South Lorrain is estimated to have close to $1,000,000 worth of ore in sight. One shoot has a width of from 4 to 5 ft. and averages from 30 to 100 oz. of silver per ton. This ore-shoot is about 150 ft. long. In the meantime the work on the new mill is proceeding satisfactorily, the building itself being completed and the work of installing the machinery progressing. The mill will be ready to operate during the last quarter of the year and will treat about 80 tons of ore per day. During the third week in August a meeting of the Ontario Mining Association was held in Sudbury. About 90% of the mines of the Province were represented. This newly organized body, with a paid secretary and supported by the leading mining men, is looked upon as likely to become one of the most influential organizations in Canada.

PORCUPINE.—The McIntyre company has purchased the Blue Diamond Coal Mines Ltd., of Brule, Alberta, the property comprising an area of about 3300 acres, which is producing over 500 tons of steam and coking-coal daily. The company is capitalized at $1,500,000. The McIntyre has also obtained an option on the Canadian Coalfields Ltd. in the same vicinity, capitalized at $10,000,000 and covering a much larger area, which is stated to contain anthracite. J. P. Bickell, a McIntyre director, states that plans are under way for the immediate development of the coal mines and that equipment has been ordered which should increase the daily capacity of the Blue Diamond to about 2000 tons.

Regarding reports as to a possible merger of the Kirkland Lake, Orr, and Teck-Hughes mines, Frank L. Culver stated that a suggestion of that kind had been made, but that the terms of such an amalgamation had not been discussed, and the proposal would only receive consideration on a basis of actual values.

THE 'PORPHYRIES'

The extreme dullness prevailing in the copper industry since the buying movement which ended last March, was sharply reflected in the reports of the so-called porphyries—Utah, Chino, Ray, and Nevada Consolidated—for the second quarter of 1920. Excepting Chino, all had to dip into surplus to meet dividend requirements; and Chino just skipped by, having earned a net profit of 38c. per share against the period's dividend of 37½c. The relatively good showing made by the porphyries in the first three months of this year, however, was a good offset to the lean earnings of the second three months. Utah with net profits of $3.14 per share for the first six months earned its dividend of $3 per share; Chino earned nearly twice its dividend, and Ray earned a margin of 14c. per share. Nevada Consolidated was the exception, showing net profits for the half year of only 30c.; dividends called for 50c. per share.

In the matter of costs, however, three of the companies showed reductions. Nevada Consolidated's cost averaged 15.56c. per pound, or 5¼c. less than in the preceding quarter. This was due to an exceptionally heavy credit to operating expenses having been received in the shape of a substantial sum from the Nevada Northern railway. Ray reduced its cost 1c. per pound, and Utah made a fractional discount from the previous three months. Chino, however, showed an increase in cost of 1½c. per pound. This was due to the higher iron content of its ore causing a lower yield of copper. Indeed the yield was less than for many months, the average for the quarter being 23.20 lb. of copper per ton against 25.66 in the preceding quarter. The tabulation below pictures earnings and costs in the second quarter of this year compared with the first, together with the dividend rates of the four companies:

	Net per share			Cost	
	Second quarter	First quarter	Current dividend	Second quarter, cents	First quarter, cents
Utah	$1.38	$1.76	$1.50	11.77	11.93
Chino	0.38	0.93	0.37½	15.28	13.91
Ray	0.24	0.40	0.25	15.34	16.30
Nevada	0.19	0.11	0.25	15.56	20.72

The average price received for copper was considerably less than in the first three months. Under the policy of the porphyries of inventorying unsold copper at 13c. per pound and with this figure and the actual sales-price striking an average, it is impossible to deduce the actual selling price they received. The reduction in the carrying price in the second quarter is from 3½ to over 4c. per pound and is clear testimony to the lean business prevailing during the period. A comparison of sales-price averages of all four companies follows:

	Second quarter, cents	First quarter, cents
Utah	18.90	21.99
Chino	18.17	21.88
Ray	18.42	21.96
Nevada	18.50	22.66

CALIFORNIA

Nevada County.—A new tube-mill is being installed at the Alta-California gravel mine near Washington. Satisfactory clean-ups have already been made with antiquated machinery. C. W. Girton is manager and the property is being paid for out of royalties.——The water is out of the 1100-ft. shaft at the Idaho-Maryland at Grass Valley and the draining of the 1000-ft. incline will soon commence.——The shaft of the Greenman quartz mine on Canada hill, owned by the Mayflower Consolidated Company of Omaha, is being sunk rapidly. The old shaft was 300 ft. deep and since renewing operations has been advanced 30 ft. The company will sink 150 ft. and there explore the vein with two drifts. It is a 2-compartment shaft, 6 by 14 ft. The equipment consists of an electric hoist, compressor, and two pumps. A test is being made of a small lot of ore at E. D. Ott's sampling works in Nevada City preparatory to making an application for permission to sell 100,000 shares of stock. Charles Dow is superintendent.

The mining companies at Grass Valley are agitated over an order issued yesterday in San Francisco by H. G. Butler of the State Railroad Commission, curtailing electric energy 20% in central and northern California except for agricultural and domestic purposes. The superintendents are making an effort to keep the mines in operation. Power is furnished by the Pacific Gas & Electric Co. and is distributed principally among the Empire, Idaho-Maryland, Allison Ranch, North Star, Alcalde, and Sultana mines at Grass Valley and at the Montana and Mayflower near Nevada City. The proposed reduction of 20% means that actual mining will practically cease until the fall rains. Every effort is being made, however, to prevent the order from being carried into effect in this district.——The removal of all underground material in the Champion mine near Nevada City was completed yesterday. The hoist at the Providence shaft will be removed to the Empire mine at Grass Valley. The property nas gone through the experience of closing down only to be later re-opened several times. There are rumors of a bond to be taken on all the company's holdings in the vicinity.

Sierra County.—The plant at the Independence mine near Alleghany, consisting of a 5-stamp mill, hoist, compressor, boarding-house, and other buildings, was completely destroyed by fire on August 13. Shortly after the fire started two explosions were heard in the mill suggesting the possibility of incendiary origin of the fire. The property was recently bonded by W. H. Griffith, supplies had commenced to arrive and preparations were being made to unwater the shaft and develop the mine.——The raise in the upper tunnel in the City of Six mine near Downieville is up more than 100 ft. and is in excellent ore. A raise is also going up in the lower tunnel as well as a cross-cut. It is the intention to drive this tunnel ahead 700 ft. to determine the length and depth of the orebody in the upper workings. Hugh McCormick is temporarily in charge.

IDAHO

Coeur d'Alene.—With the Nabob mill in operation and its underground work showing up well, and increased activity in a number of other properties, the Pine Creek district is beginning once more to attract attention. Good reports from the development work under way on the Sidney mine, where a drift on the vein has been driven 150 ft. east of the shaft, show a well-mineralized lode carrying lead, silver, and zinc. This drift will reach its objective in another 100 ft., where it is expected to open a body of ore previously disclosed in the upper levels.

Work of the Red Monarch Mining Co. will be resumed

soon. It is expected either to drift or sink, or perhaps both, on the vein that was struck when the 4000-ft. adit was driven two years ago. The vein is at 3000 ft. and is one of three promising lodes cut by the long cross-cut. The company has a compressor-plant and other machinery for development.

The production of lead, zinc, and silver from the mines of the district is greater to date than for the same period of 1919. In 1918, the mines of Idaho produced 294,695,993 lb. of lead, but the total output in 1919 was about 184,079,000 lb. The output of recoverable zinc in Idaho decreased from 45,161,172 lb. in 1918 to about 16,565,000 lb. in 1919. If the Callahan Zinc-Lead Co. continues to ship zinc ore and concentrate at the present rate, about 3500 tons per month, the output of zinc in 1920 will be larger. The production of silver in Idaho in 1919 was about 7,700,000 oz., valued at $6,340,000, the lowest output for the last three years. The average annual output for the last ten years was 9,730,180 oz. The producers of silver-lead ore in the Coeur d'Alene district are making larger shipments than in 1919, especially the Bunker Hill, Morning, Hecla, Hercules and Tamarack, and Custer mines.

MISSOURI

Joplin.—The Butte-Kansas Mining Co. has begun the operation of its new mill, which was erected near the site of the old plant that was seriously damaged by a cave-in at the mine on June 1. Operation continued for a full 10-hour shift, during which time a carload of concentrate was made. All machinery in the plant worked perfectly and there was not a hitch anywhere. Following the cave-in on June 1, preparations were made to re-build immediately and construction work started June 17. The new plant is of 400-ton capacity. The company has continued development of its lease and as a consequence continuous production is assured. One of the new holes shows a face 65 ft. thick that averages 19½%. Another hole has a face of 210 ft. of 9½% ore.

MONTANA

Butte.—Details of the compromise agreement between Anaconda company and the W. A. Clark interests whereby Anaconda gives to the latter a portion of the Emily vein under the surface of the Pilot-Butte claim have not been disclosed, but it is known to be a notable victory for the Clark interests. A vein apexing in the Elm Orlu claim, the prior location, was found to unite with the Emily on its dip at about the 2400-ft. level of the Pilot-Butte, where the orebody has a width of approximately 50 ft. with the grade of ore ranging up to 6% copper, with some silver. Anaconda, some years ago, instituted suit against the Pilot-Butte, claiming the Pilot-Butte's chief fissure, the Emily, on the ground of extra-lateral rights, purchasing the property later for $1,125,000. Certain interests that had been connected with the Pilot-Butte asserted that this sum was insufficient, in view of the size of the orebody disclosed.

MEXICO

Dispatches dated August 23 state that Pedro Zamora has released six of the Americans who were kidnapped recently by him in the State of Jalisco, but is holding one American, W. A. Gardner, superintendent of the Esperanza mine, for a ransom of ₱100,000 and W. B. Johnson, a British subject, for ₱50,000. Charles Hoyle, manager for the Esperanza Mining Co. at El Oro, and Mrs. Hoyle, have been released and are now safe at Penas, on Banderas bay. The names of the other four Americans set free are given as Dietrich, Gillis, Culvert, and Nels. These four are at Mesa del Corazon. J. C. Bryden, representing the Esperanze company in Mexico City, today said nothing regarding a ransom for the Americans captured had been received, but that the money was ready for payment when the demands were presented. He explained the presence of Hoyle and the other Americans in Cuale, where they were captured, by saying that they left El Oro to inspect a mine in that vicinity.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Oscar Lachmund is at Canton, China.

Andrew W. Newberry has returned from London to New York.

Arthur J. Stewart has moved from Cottage Grove, Oregon, to Los Angeles.

A. C. Block, recently of Brownwood, Texas, is at San Diego, California.

H. R. Bischoff has gone from Stillwater, Minnesota, to Larder Lake, Ontario.

James O. Greenan, lately at Mina, Nevada, has gone to Dawson, in the Yukon.

D. D. Irwin has become superintendent for the Moctezuma Copper Co. at Nacozari, Mexico.

Donald F. Irvin has returned to San Francisco after an extended stay in South America.

Lewis A. Levensaler has gone to Nome, Alaska, and will not return to Seattle before October.

Felix McDonald, superintendent of mines for the Inspiration Con. Copper Co., is visiting California.

J. P. Montague, formerly superintendent of the Big Pine mill, Manhattan, Nevada, is now at Tonopah.

A. W. Rogers, representing the Central Mining Corporation, has returned from New York to London.

F. C. Schrader, of the U. S. Geological Survey, is making an examination of the Jarbidge district, Nevada.

C. T. Ulrich, secretary for the Kennecott Copper Corporation, is making a trip to Western mining camps.

J. D. Shilling, general superintendent of the Utah Copper mine, is spending his vacation at San Diego, California.

F. L. Bosqui, now residing in New York, paid a short visit to San Francisco, in the interest of Charles Butters & Co., London.

F. L. Stack has left the Cia. de Santa Gertrudis at Pachuca, Mexico, to join the staff of the Chile Exploration Co., in New York.

Y. Nakayama, metallurgical engineer with the Furukawa Mining Co. of Japan, has been visiting mining and metallurgical plants in Utah.

F. R. Raiff, traffic manager for the American Smelting & Refining Co., with headquarters in New York, has been in Utah and Idaho recently.

Ernest G. Ashby, chief accountant for the Julian Alaska Mines Co. and auditor for the Algunican Development Co., has returned to Montreal.

Harry P. Hill, formerly foreman of the Clay mine of the Arizona Copper Co., at Morenci, Arizona, has accepted a position as superintendent of the El Bordo group of mines, which is controlled by the Santa Gertrudis company, of London.

Spencer W. Clawson, pioneer mining engineer, died at his home in Los Angeles on August 15. Mr. Clawson came West in 1880 and settled in Arizona. He became identified at that time with the Contention mine in Tombstone and later was associated with some of the biggest mining enterprises in the country. For 23 years he was manager of the Copper Queen Consolidated in Bisbee and then he went to Los Angeles and opened offices as a consulting mining engineer. He returned to Arizona as consulting engineer to the Arizona-Michigan Co. and two years later went to Parral, Mexico, in the interests of a gold mining company. He was driven from that country by Villa and again returned to Los Angeles.

THE METAL MARKET

METAL PRICES

San Francisco, August 24

Aluminum-dust, cents per pound	65
Antimony, cents per pound	8.50
Copper, electrolytic, cents per pound	19.00
Lead, pig, cents per pound	9.25—10.25
Platinum, pure, per ounce	$115
Platinum, 10% iridium, per ounce	$105
Quicksilver, per flask of 75 lb.	$80
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

August 23.—Copper is inactive but firm. Lead is quiet but strong. Zinc is moderately active but higher.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Aug. 17	97.25	59.75	July 12	92.18	52.66
" 18	98.00	60.50	" 19	91.04	52.91
" 19	98.50	61.00	" 26	92.39	54.77
" 20	101.75	63.75	Aug. 2	92.85	56.20
" 21	101.75	63.75	" 9	94.58	58.39
" 22 Sunday			" 16	95.39	59.05
" 23	97.50	60.87	" 23	99.12	61.60

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	....
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Aug. 17	19.00	July 12	19.00
" 18	19.00	" 19	19.00
" 19	19.00	" 26	19.00
" 20	19.00	Aug. 2	19.00
" 21	19.00	" 9	19.00
" 22 Sunday		" 16	19.00
" 23	19.00	" 23	19.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	....
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Aug. 17	9 12	July 12	8.25
" 18	9.15	" 19	8.45
" 19	9.20	" 26	8.93
" 20	9.20	Aug. 2	9.06
" 21	9.25	" 9	9.00
" 22 Sunday		" 16	9.06
" 23	9.25	" 23	9.19

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	....
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	....
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	....
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Aug. 17	8 40	July 12	8.15
" 18	8.40	" 19	8.24
" 19	8.40	" 26	8.22
" 20	8.40	Aug. 2	8.11
" 21	8.45	" 9	8.12
" 22 Sunday		" 16	8.27
" 23	8.45	" 23	8.42

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	....
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Aug. 10	88.00
July 27	88 00	" 17	85.00
Aug. 3	88.00	" 24	80.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	....
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	....
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

MONEY AND EXCHANGE

"Were shipments of great quantities of gold possible, even if that were desirable," said F. R. A. Shortis, vice-president of the Guaranty Trust Co., "the decline in Sterling exchange would be arrested immediately; but although Great Britain is not in a position to liquidate her indebtedness to America in gold, she holds abundant tangible assets, which America could have today, as good in intrinsic value as the American securities which the British people have already sold back. If the United States would adopt the policy of purchasing securities now held by Great Britain to the degree that Great Britain invested in American securities before the War, estimated at $10,000,000,000, the difficulty would be solved at once. I am aware, however, that while American securities always appeal to British investors, British securities of equivalent intrinsic value have not appealed to American investors. For this there have been certain well-defined reasons, including the field for domestic investments presented by the development of this newer country. I am aware also that American farmers and manufacturers and merchants require money, rather than securities, for their products, and that bankers are required to keep their depositors' funds liquid, but nevertheless it is unfortunate that the investing public of this rich country cannot, for the time being, be induced to invest in foreign securities.

"The debt of Great Britain to the United States today approximates $5,000,000,000, made up of $772,000,000 of Government loans and of $4,280,000,000 of other credits on behalf of the British government. Until the loans that are placed in this country mature, they will not, of course, affect the exchange situation. Sterling exchange is declining because British exports are not at present sufficient to pay for current imports. The recent decline is due to the large supply of grain bills offered. So far, very little cotton exchange has been offered.

"This decline in Sterling exchange will operate automatically to increase the cost of British imports and thus prove to be a blessing in disguise. It will, on the other hand, stimulate British exports to the United States. While the curtailment of American export trade, because of a low Sterling exchange, may be a hardship for the time being, we must recognize that the British are by this method adjusting their international account with Americans and that eventually this will be to America's advantage as well as to Britain's. Until the British are able to adjust their indebtedness to the United States, the decline in exchange will provide the only effective method of forcing Great Britain to economize, and the more the exchange declines, the greater will be the effect.

"The restriction of imports into Great Britain and the encouragement of exports are not, however, the only economic force thus brought into play. Because of the low Sterling exchange, investments in British securities are made exceptionally attractive. Under present exchange conditions these securities can be bought at a discount, in fact, at a discount which is exactly the same as the premium which British purchasers have to pay on commodities imported from the United States. Should the American investor disclose a disposition to take advantage of this situation, he could have a wide choice of gilt-edged investments, including railway debentures, municipal bonds, and many other securities based on tangible assets."

Foreign quotations on August 24 are as follows:

Sterling, dollars:	Cable	3.55¼
	Demand	3.56
Francs, cents:	Cable	6.90
	Demand	6.91
Lire, cents	Demand	4.60
Marks, cents		2.00

Eastern Metal Market

New York, August 18.

All the markets are under the influence of seasonal inactivity and there is 'little doing' in any of them.

Conditions in the copper market are unchanged and prices are generally firm to steady.

The tin market is without life in any department.

Lead is the strongest of the markets with the price tendency higher and supplies still inadequate.

The zinc market shows more activity than in recent weeks, but it is not marked. Prices are higher.

Antimony is unchanged in any respect.

IRON AND STEEL

In the pig-iron market sellers appear to be sold well ahead and are accepting new business with caution. Consumers have been rushing to fill nearby deliveries as fully as possible and as a result some sellers are reported to be asking fancy prices. The market has reached the point where makers are no longer anxious and examine all orders carefully. Some predict that prices will continue high for some time.

There is an active demand for sheets which is centring on galvanized products just at present. There is a good demand for large sizes of black sheets.

In general the market is quiet with most producers active. Railroad conditions are improving and shipments on contracts are progressing with more speed. August is always a dull month and no developments of interest are transpiring.

COPPER

While business is reported to be light, sentiment is considerably improved. The leading producers have done a moderate business during the past week, but it cannot be said that buying is even normal. They maintain prices at 19c., New York, for both Lake and electrolytic copper for delivery to November 1. The better feeling is explained as being due to a depletion of stocks in the hands of speculators. There is talk of an advance in quotations by some interests despite the inactive market, in order to meet the increased costs, inevitable as a result of freight-rate advances. For the first time in more than a month bids by buyers appeared on the New York Metal Exchange; this was a surprise. They offered 18.25c. spot, August and September, and 18.50c. for October, but sellers held firmly at 19c. and 19.25c., respectively. Foreign demand is not as active as previously, due to lower values for exchange and to political conditions in Europe. Copper output in August is not expected to show any improvement over July.

TIN

Conditions in this market are pronounced by traders as duller than in many months, even more so than many can recall. The leading consumers are still out of the market and this has been a feature for some weeks. Even dealers and speculators are taking no interest. The market may be characterized as dull and steady with prices for spot Straits tin largely nominal at around 48c., New York, which was the quotation yesterday. Import prices are around 48 to 48.25c. There is an absence of any transactions on the New York Metal Exchange, none having been reported last week against only 25 tons the week before. There have been some offerings of Chinese tin at 43.50 to 44c., New York, which has tended to interfere with demand for better grades. An unusual occurrence has been the non-arrival of any tin for some days or almost a week. The receipts this far this month have been about 3000 tons with 5545 tons still afloat. The London market was steady yesterday with spot Straits quoted at £285 per ton and spot standard at £274 10s. with futures at £281 15s.

LEAD

The leading interest advanced its price on August 12 another ¼c., bringing it to 8.25c., St. Louis, or 9c., New York. The outside market had been up to this level for some weeks so the change was not a surprise and was regarded as entirely warranted. While demand is not heavy and is still largely confined to early-delivery metal, the fact that supplies are meagre constitutes an element of strength. In the outside market spot and early-delivery lead has sold as high as 9.12½ to 9.25c., New York. Nothing is obtainable at 9c., New York, except from the American Smelting & Refining Co., providing it has it to spare. The first purchases of English lead are now arriving here, 400 tons having been received a few days ago.

ZINC

A much better sentiment prevails and prices are advancing. There has been more interest from consumers but the market cannot be said to be active. Prime Western for early delivery is quoted at 8.05c., St. Louis, or 8.40c., New York, at which level sales have been made. There have also been sales made for September at 8.10c., St. Louis, and for October at 8.15c., St. Louis. There is considerable uncertainty as to far-forward delivery prices, due to the effect of freight-rates on costs, etc. There is some talk of an advance in prices soon because of this. There are reports of a distinct shortage of stocks which by some is pointed to as a decided influence. It is stated that the supply has fallen to a point where producers have become buyers to cover delivery obligations.

ANTIMONY

The market continues dull with no change in prices which are 7.25c. per lb., New York, duty paid, for wholesale lots for early delivery. Jobbing lots are ¼c. higher.

ALUMINUM

Virgin metal, 98 to 99% pure, continues obtainable at 33c. per lb., New York, from the leading interest, with 31.50 to 32.50c. per lb., asked by other sellers. These apply to wholesale lots for early delivery.

ORES

Tungsten: The market continues inactive with prices unchanged around $5 to $5.50 per unit and up. There has been a little business but it is regarded as difficult to do any because prices are too low or under the cost of production. Bolivian ore is about $6 to $6.50 per unit.

Molybdenum: Conditions are unchanged with the market quiet and prices nominal at around 65 to 75c. per lb. of MoS_2 in regular 90% concentrate.

Manganese: There is almost no business and prices are nominal at 70c. per unit for high-grade ore.

Manganese-Iron Alloys: The summer dullness has permeated this market. Inquiry for ferro-manganese is limited to moderate quantities for early delivery, for which around $200 per ton, delivered, is the price. The spiegeleisen market is strong, some sellers asking $82.50 furnace and others $85.

A market letter from London says: "The movement of prices for silver has been upward. India is not much in evidence as a buyer. There have been some purchases for China, where, despite the lack of export business, great demand for the metal for speculative purposes in India, has created a market. The strength does not lie so much in the moderate demand as in the fact that the United States is unable or unwilling to feed it. Some silver from America has been sold here, and some has come from the Continent."

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

A NOVEL DREDGE-LIGHT

The accompanying illustration shows a make-shift apparatus devised by the Dredging Department of the Bethlehem Shipbuilding Corporation for lighting the bow and stern of its gold-dredges. It consists of an old automobile headlight mounted on a hinge with a ½-in. bolt bent in the form of a quadrant, with notches filed in the quadrant so that it

A Novel Dredge-Light

can be centred at any angle and held there. The light is pivoted in a horizontal direction and held with an ordinary clamping-bolt. The whole arrangement is mounted on a piece of 2½-in. pipe and is used in repair work on the bank, or at the stern of the dredge. It is easy to adjust this light so as to throw the rays exactly where wanted.

The picture of the man in front is that of an old dredge operator, but due to his modesty his name is withheld.

BIG TRUCKS CAUSE LESS ROAD-WEAR

There is probably no more vital nor widely discussed topic of interest in the motor-truck industry just now than the relation of heavy-truck duty to road-wear. Much opinion has been expressed to the effect that large-capacity vehicles, by virtue of their greater weight, are in some measure responsible for excessive road deterioration. Some interesting facts in this connection were brought out recently in an interview with R. E. Fulton, vice-president of the International Motor Co., manufacturers of Mack trucks. "No one realizes better than the motor-truck manufacturers", said Mr. Fulton, "the necessity of putting into force legislation which will preserve the roads and enable this country to approach more rapidly its ultimate state of highway perfection. It is doubtful, however, whether the policy which is now pursued of restricting large-capacity trucks will be effective in accomplishing this end. There are but two possible ways of preserving the roads through legislation: either the total tonnage of traffic passing over the roads must be reduced or the road-wear per ton of material transported must be decreased. Barring the heavy-duty truck is an attempt to save the roads by the first method. The elimination of this most economical of motor tranportation units tends to make the cost of highway transportation prohibitive. If eliminating the 7½-ton truck would divert the freight formerly carried in those units to some entirely different transportation agency then its elimination would reduce road-wear. The other carriers are not able to cope with the traffic already in their own legitimate sphere. Therefore, if this freight is to be moved at all it must go over the highways in a larger number of light vehicles regardless of the increased cost of such transportation.

"Apparently the object of prohibiting the 7½-ton truck is to decrease total tonnage over the highways. Let us see how it works out. The average truck of one-ton capacity weighs by itself approximately two tons. On the other hand, in a 7½-ton truck there is less than one ton of vehicle weight for each ton of freight capacity. This means that in transporting seven tons of material in one-ton trucks, 21 tons of traffic (total weight of vehicle and cargo) will pass over the roads, whereas if transported in a 7½-ton truck the road will have to bear only 14 tons of traffic. In other words, the tonnage formerly shipped in 7½-ton trucks would have to be decreased 33% before there would be any actual reduction in the volume of traffic. Furthermore, to even approach the economy of the heavy-duty truck in bulk-hauling, the light vehicle must resort to excessive road speeds, which have been definitely proved to be more destructive than increased weight.

"Although it might be advisable at the present time to decrease the tonnage transported over highways, it is not possible to do so because there is no other agent capable of taking over this traffic. Thus the only alternative is to direct legislation toward reducing the road-wear per ton of materials transported. The results of tests recently conducted by the Bureau of Public Roads at Washington indicate clearly the way in which this can be done. These tests show that the road impact is the principal cause of highway destruction, and also that the road impact does not necessarily increase in direct proportion to the size of the truck, but is governed by the amount of weight which a truck carries below its springs. For instance a 5½-ton chain-driven truck fully loaded delivered only 68% of the road impact pressure produced by a 3-ton shaft-driven truck operated under the same conditions. This is accounted for by the

fact that a chain-driven truck carries all of its driving mechanism on the frame above the springs, whereas in a shaft-driven truck the entire weight of the final drive and its housing rides directly on the rear axle and the blow which this delivers to the road is unrelieved by springs.

"Not gross weight but actual pressure on the road is the all-important thing to be considered in framing laws to protect the highways."

MULTIPLE-CYLINDER AMMONIA-COMPRESSOR

Marked innovations in design, resulting in exceptional simplicity and reliability, are claimed for the Norwalk refrigerating plant, a product which has recently been added to the line of the Norwalk Iron Works Co., South Norwalk, Connecticut. The Norwalk company has during the past 40 years built up a world-wide demand for its air and gas-compressors, and its reputation for quality products is fully sustained in this new product.

The plant is of the multiple-cylinder ammonia-compressor type. It is furnished with motor or gas-engine drive, and is thus equally suited to city or country use. The fundamental design is standardized, so that while the cylinders and operating parts are adapted to the various capacities, the principle of construction remains unchanged throughout the whole line. This policy, the Norwalk engineers point out, has resulted in a degree of efficiency which would not otherwise have been possible.

The internal mechanism of the Norwalk plant is free from bolts and nuts, a big factor in avoiding derangements. There is nothing to work loose and call for adjustments or replacements. The operating parts are few and rugged. The drive is by eccentric shaft, and a feature typical of Norwalk simplicity is the floating ring-bearing used between the eccentric ring and the ring on the connecting-rod. This ring-bearing turns constantly under the action of the connecting-rod ring, and, being of softer metal than the rings between which it functions, it takes all wear. The major parts of the mechanism are thus protected for long life, while the ring-bearing can be replaced when necessary at trifling cost.

This policy of having the mechanism automatically safeguard itself is applied at all points, resulting not only in uninterrupted efficiency and economy but also in exceptionally long life for the whole plant. Another departure which has had a great deal to do with the success of this plant is the use of graphite semi-fluid lubrication, instead of oil. One of the problems in mechanical lubrication, especially in the smaller types of machines, has been due to the oil volatilizing and passing out into the refrigerating system. This not only meant poor lubrication but at the same time seriously interfered with the refrigerating process. Norwalk lubrication is declared to be trouble-proof.

AN AMERICAN-MADE GOLD-DREDGE FOR NEW ZEALAND

An example of the far-reaching activities of American industry is to be found in a gold-dredge that has been designed and constructed in New York for the purpose of operating in New Zealand goldfields. This dredge is being built by the New York Engineering Co. and is similar to the dredge constructed for operations in Alaska. The hull is 115 ft. 6 in. overall; beam, 50 ft.; depth, 11 ft.; and is built of native pine. Power for dredging, pumping, and shifting position is furnished by Westinghouse electric motors, while twelve men, four men to a shift, constitute the crew.

The general method of dredging is as follows: The digging-ladder carrying the buckets is lowered and dirt is scooped up. This dirt is dropped on the conveyor-belt and is carried to the screen. Here it is screened and washed and the refuse is dropped from the screen to another conveyor-belt, where it is carried to the stacker and deposited. The pay-dirt that remains is further washed on gold-tables and then passed to a gold-box where the gold is recovered. The r maining deposit in this gold-box is treated about once a week with mercury so that most of the gold is obtained either in nuggets or in the form of an amalgam.

A winch motor is used to change the position of the dredge. On frequent occasions the dredge is shifted to shoal water, and the pumps must then be operated before it can be re-floated.

The digging-ladder carrying the buckets is 100 ft. long and weighs 110,000 lb. There are 73 buckets, each bucket, empty, weighing 3000 lb., with a load-capacity of about 10.5 cwt. When in operation, 18 buckets per minute are dug, and a linear speed of 54 ft. per minute is obtained from a 200-hp. slip-ring motor with a magnetic controller for reversing and 50% speed-reduction.

The screen is 40 ft. long with diameter of 7 ft. and weighs approximately 6500 lb. A 50-hp. slip-ring motor operates this screen at seven revolutions per minute. About 8000 gallons of water is used per minute in washing and the three pumps (high-pressure, low-pressure, and nozzle-pumps) are driven by Westinghouse squirrel-cage motors of 125, 60, and 25 hp., respectively.

The conveyor-belt for transportation of dirt from the screen to the stacker is 42 in. wide and 130 ft. long, and the stacker is operated by a 40-hp. slip-ring motor. Winch-drive is furnished by a 25-hp. slip-ring motor and a 10-kw. transformer is used for lighting purposes. All motors are of the three-phase, 60-cycle, 2200-volt, alternating-current type, and have special impregnated windings to protect them from moisture. Complete protection is afforded the motor by overload and no-voltage release; a time element attachment is furnished which permits a fixed overload for a definite time before releasing.

Power is furnished by a hydro-electric plant and feeders are run along the ground to the dredge. As alternating current is used, the dredge can be operated a considerable distance from the plant. Dredges of this type have operated on a cost basis of 6½c. per cubic yard and in one instance where records were available, 418,745 cu. yd. has been dug in a period of two years.

COMMERCIAL PARAGRAPHS

Rickard & Sloan, Inc., purveyors of 'Productive Publicity' have moved their offices from the Evening Post building to 25 Spruce street, New York, where they will have more ample quarters for their growing business.

On September 1, 1920, the **Flexible Steel Lacing Co.** will occupy its new factory at 4607-4631 Lexington street, Chicago. The company's entire facilities will be devoted to the manufacture of Alligator steel belt-lacing, high-duty belt fasteners, Turtle belt-fasteners, Flexco lamp-guards, and Flexco-lok lamp-guards.

The Oxweld Acetylene Co., the world's largest manufacturer of oxy-acetylene welding and cutting apparatus, has established Pacific Coast sales and distributing headquarters at San Francisco, with offices at 1077 Mission street. Additional sales representatives' office are maintained at the following points: Los Angeles, 646 Maple avenue; Salt Lake City, 908 Kearns Bdg.; Portland, 90 First street; Seattle, 433 Pioneer Bdg. Leo Romney, with headquarters at San Francisco, is Pacific sales manager. The territory embraces the States of Washington, Oregon, Idaho, Utah, Arizona, California, Nevada, and the counties of Lincoln, Sweetwater, and Uintah in Wyoming. This territory was formerly served from Chicago and Los Angeles. Removal of headquarters to San Francisco was made necessary to secure a more central location for supplying the company's rapidly growing business in the Pacific States where Oxweld apparatus is extensively used in the metal industries and shipyards.

T. A. RICKARD, ... Editor

NAMES of the 'investors' in Mr. Ponzi's get-rich-quick scheme have been published by the Boston 'Post'. We can imagine what a rush there must have been on the part of Mr. Rice and other 'fiscal agents', especially those engaged in the art of incubating oily wild-cats, to get hold of this list of 'suckers'. To them it will be a mine, more real than those in which they invite 'investors' to put their money.

LAST week several Republican newspapers came out with a flaring head-line stating that the British embassy at Washington had contributed $87,500 to the Democratic campaign fund. This was corrected next day in small print. Now Mr. Myron Herrick says that "western European statesmen are hoping for a return of the Republican party to power". This, of course, is featured in the Democratic press. Thus one bit of silliness balances another. Meanwhile a more serious statement is made that "British interests take a hand in California senatorial fight". It appears that a local publication, 'The British-Californian', objects to one candidate as a "dangerous demagogue". Forthwith, there is foolish talk of "sinister foreign influence". Undoubtedly a paper avowedly conducted in behalf of British residents in California has no business to take sides in the senatorial election. Indeed, it is most undesirable that any publication should be published on non-American lines and for the purpose of promoting solidarity among foreigners.

SOME of these 'literary gents' have queer ideas about mines. For example, in the current 'Atlantic Monthly' we read this: "Authors are like miners: they put the precious metal into their books; but when one gets to the mine, there is apt to be a lot of 'slag' about!" The exclamation mark is well placed. The simile is mixed. Apparently the idea is that as authors put precious things into their books, so miners put precious metal into their mines, that is, they 'salt' them; but when you read the book you find a good deal of piffle scattered over the pages, and when you go to the mines you find heaps of slag. The comparison might hold, if miners made slag at the mine; they don't; the slag is made at the smelter, which usually is far from the mine. For 'slag', read 'rock'. Part of the slag in the 'Atlantic' quotation is to be found in the word "apt", which is out of place. The word means 'suitable' or 'appropriate'; it is not a correct synonym for 'likely'. However, it is fair to add, the article that contained the above-quoted slag also contained several bits of crystalline gold.

CHARGES and counter-charges of an excessive use of money for campaign purposes are being made by both political parties, thereby continuing the exposures that were started before the meeting of the conventions at Chicago and San Francisco. The facts will disgust the public and tend further to decrease interest in a presidential campaign that so far has evoked but scanty enthusiasm, largely because neither nominee commands admiration. Senator Harding states that the millions collected by Messrs. Upham and Hays for the Republican cause "are essential to our success in planning for national enlightenment and are all deeply appreciated by me". Why not say, in the best front-porch manner, that they are "essential" to the "evolvement" of "normalcy". A bitter fight is looming, and in the course of it we expect to see Governor Cox's war record exposed. Through his newspaper he expressed opinions that are thoroughly discreditable. For ourselves, we wish that the vice-presidential candidates were on the same ticket and could be elected in lieu of their leaders.

PRAISEWORTHY co-operation and a spirit of fair-dealing on the part of miners, mine-operators, and members of the Industrial Accident Commission of California has resulted in the formation of a set of Mine-Safety Orders that is definite and complete, and that affords reasonable protection to workmen without imposing impracticable and unworkable restrictions on the companies owning mines and metallurgical plants. In 1915 the Commission adopted mine-safety rules, which have lately been revised by a committee composed of mine-operators and sundry officials from organizations of mine, mill, and smelter employees, who, upon invitation, collaborated with the engineers of the Commission. As a result, a tentative draft of the new orders was printed and distributed among those connected with the industry, and last week a public hearing was held to receive any protest or criticism before the final form of the orders should be determined. One proposal directed that stoping should be done in such a manner that the back at any time could be tested, either from timbering or broken rock, with a seven-foot bar. It was pointed out at the hearing not only that this was sometimes impracticable, but that, for instance, in some stopes where shrinkage methods are employed, additional ore is drawn

off for the specific purpose of preventing accidents. The Commission accordingly will amend the regulation so as to permit its engineers to determine the procedure according to the methods and conditions in particular mines. Another proposal fixed five years of practical experience underground as one qualification for a mine superintendent. It was recommended that this be changed to three years for a superintendent employing more than 25 men, and two years where less than that number is employed. Apparently, the policy of the Commission is to avoid making orders that are unreasonable or unjust; a natural corollary would be insistence on strict compliance with the regulations that are made; laws that are not enforced are worse than no laws at all.

The Struggle at Rio Tinto

On July 8 began the greatest strike in the history of Rio Tinto, the famous copper mine in Spain. The property has been involved in a sort of perennial labor-war for several years, with brief intervals of peace. In the beginning the agitation was provoked by German agents in order to hinder the output of copper and pyrite for the Allies. The Red variety of socialist was employed by Germany in this work, not only at Rio Tinto but throughout Spain. Syndicalism was developed with the thoroughness and finish so characteristic of German economic institutions, for the principle of completeness serves destructive as well as constructive purposes. It was the masterly devilishness of this highly perfected anti-social organization, bearing the brand 'Made in Germany', that plunged Mr. Frank A. Vanderlip into a panic of post-prandial panegyrics upon Spain and the Spanish people while he stood upon the volcano of Spanish terrorism in Barcelona, although he promptly substituted a deluge of diatribe as soon as he had passed safely beyond the border.

Spanish syndicalism is startling to one who is unaccustomed to the red torch with which Germany has lighted the social conflagration in Europe. It has been met by measures less oppressive than we would deem warranted in this country under like provocation, but the preparations to combat a general uprising are more elaborate than appear upon the surface. Nevertheless, the Rio Tinto strike, involving 10,000 workmen, quickly followed by the strike of iron and steel workers at Bilbao, where 40,000 men have made a determined stand against the authorities, surpasses any demonstration that has been witnessed previously in the Peninsula. Agitation against the Rio Tinto Company has enjoyed a certain popularity throughout the country, which undoubtedly has facilitated the propaganda of the syndicalists. Like all government-owned mines, the Rio Tinto was an incubus upon the State for generations; it was operated at a loss, just as the famous Arrayanes lead mine at Linares has always been a failure, and as the Almaden quicksilver mine shows a deficit, in any period of five years, despite its marvellous orebodies with their fabulous tenor of 8% of mercury. Accordingly, the Rio Tinto was sold to an English company in 1872, and after a long financial struggle, involving the investment of enormous capital, it was placed firmly in the position of a steady producer of profit, the gross amount of which appears stupendous in the eyes of demagogues. It is the fashion, therefore, when less urgent matters demand attention, to rail at the opulent Rio Tinto Company, which is accused of despoiling Spain of her resources.

The strike started as usual with the workmen employed in the smelter, which is the smaller part of the Rio Tinto operations. In two days the entire enterprise was paralyzed, even the railroad men and telegraphers joining the strike. Communication with the port of Huelva was maintained by running a mail-train manned by members of the English staff. The cessation of traffic, on which the town depended for the necessaries of life, immediately brought the population face to face with famine. A committee of women appealed to the manager, Mr. Walter J. Browning, to make concessions to the workmen in order to avert starvation. He refused to be coerced by sympathy, and told them to send their husbands back to work, but to each visitor he gave five pesetas ($1) as a gratuity. The local authorities then petitioned the Council of Ministers at Madrid, which resulted in a request from the Governor of Huelva to the president of the workmen's syndicate for a proposal that might serve as a basis for discussion with the Rio Tinto Company. The reply was an insistence upon recognition of the union and the syndicate, following which terms of settlement would be offered. This was repudiated, but it is interesting to note that at this juncture a movement for conciliation took place within the ranks of the strikers. Although it was stopped by the labor leaders, it possesses significance. For many months before the outbreak of the trouble, rumors of an impending crisis had been coming to the United States in the form of letters from conservative workmen begging an opportunity for employment here, alleging that they were being coerced by the radical element under non-Spanish influences, and, being unable to resist this pressure, they were eager to escape before the storm should break. Their idea was to settle in a country where they could do an honest day's work for an honest day's wage and rear their families in peace. This episode indicates that there exists a rational element, around which, as a nucleus, a loyal body of workmen may be built. The problem there, as well as in the United States, is to get rid of the foreign agitators.

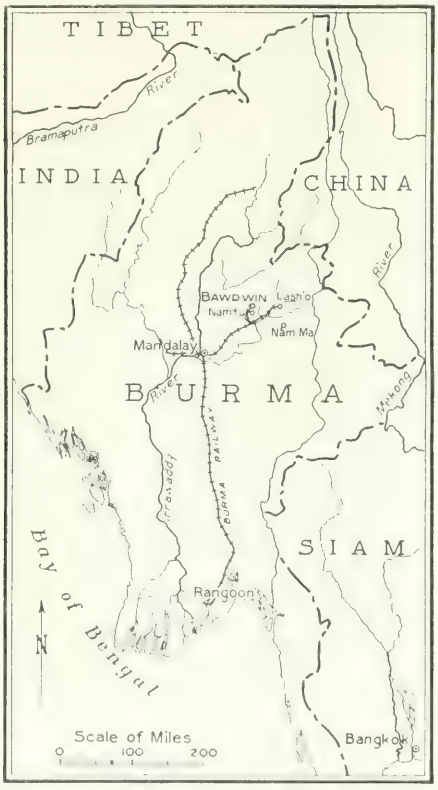
The Government next appointed Señor Leopoldo Palacios, of the Instituto de Reformas Sociales, a branch of the public service presided over by the distinguished sociologist, Señor Adolfo Posada, to make an effort to effect a compromise. This brought out concrete demands from the union that embraced reinstatement of all striking workmen, pay for time lost during the strike, regulation of pensions and contributions for medical and other benefits, and an increase of 50 to 65% in the wages paid. Mr. Browning proposed an increase of three reales (about 15 cents) on all wages from three pesetas upward, a doubling of all wages below three pesetas, and some minor concessions. The deadlock was complete, and Señor Palacios retired, admitting his inability to settle the

dispute. Meanwhile seven steamships that had been chartered to load pyrite at Huelva were obliged to sail in ballast, and a steady emigration of laborers from Rio Tinto began. Hundreds of men have deserted the mine, avowing their determination never to return. These include many of the most capable and reliable, so that the preponderance of the radical type is increased, which will augment difficulties in the future. The union insists that this must be a conclusive contest, and evidently the company has accepted the gage of battle. To surrender now would mean ceaseless heckling and practical dictation by the agitators, which would render economic operation impossible. It is an unfortunate moment for the miners at Huelva, owing to the rapid increase in the competition of brimstone as a basis for sulphuric-acid manufacture. The American demand for pyrite has fallen enormously with the general change to sulphur-burning at the acid-works in this country. The purity of the acid made from brimstone as compared with the acid made from pyrite, which always contains some arsenic, is raising the standard and giving the advantage to the sulphur producers of Louisiana and Eastern Texas. In the face of a diminishing American market for Spanish pyrite, the syndicalists have chosen an inopportune time to make demands that would increase the cost of producing ore at Rio Tinto. The wages paid have been low, but they were on a par with those prevailing in other parts of Spain. To ameliorate the hardships of the workers without setting new standards of compensation, the Rio Tinto Company has long been selling supplies at a loss through its fourteen stores, undertaking in this manner to sustain the resources of the laboring men in the face of rising prices. For example, the company stores have been selling a daily average of 40,000 pounds of bread at a loss of 26% on the cost price, 400 gallons of olive oil at a loss of 23%, 2200 pounds of sugar at a loss of 33%, and other articles in proportion. The wholesale price of flour in Spain on July 1 was at the rate of 10 cents American per pound, sugar sold for 26 cents, beans for 4 cents, rice for 7½ cents, and olive oil for $1.25 per gallon. In addition to the consideration shown in supplying the prime necessaries below cost, the Rio Tinto Company has built model villages of commodious houses, in which every modern sanitary convenience has been provided, and these houses are rented to workmen at less than the cost of crowded unhealthy quarters in the manufacturing towns. The better class of laborers have seemed content with the conditions, and have asked only that they be freed from the agitation of the Red leaders, but the present struggle has led to an impasse that will embitter the people for a long time to come. They have been led to believe that the attitude of the manager has not been sanctioned by the board of directors in London, and that he is personally hostile. Intense excitement was produced by a report that Mr. Browning intended to shut off the water-supply from the town and was prevented from doing so only by the intervention of the local political authorities. He is also blamed for the suspension of freight deliveries, regardless of the fact that the railroad operatives have joined the strikers. The Spanish view of the situation at Rio Tinto before the outbreak of the strike has been presented in a novel entitled 'The Metal of the Dead' by Concha Espina, one of the most talented writers of the country, a book that has just been published. It will help to reveal the serious problem faced by the Rio Tinto Company, which in some respects is national, if not, indeed, international.

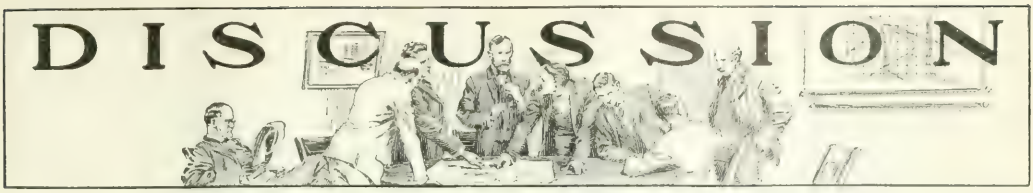
The Burma Corporation

In these days when entire mountains are being carried piecemeal to leaching-plants and concentrators, a mine with an ore-reserve of 4,732,003 tons is no longer astonishing. If, however, in addition to 1.2% of copper, in itself enough to promise profitable exploitation under favorable conditions, the ore contains an average of 18.2% zinc, 26.4% lead, and 24.5 ounces of silver per ton, the total of 4,732,003 tons becomes an impressive quantity. If only 80% of the metal contents of this ore were recovered and sold at the present market prices, the proceeds would amount to nearly 500 million dollars. These figures, except for the calculation as to the estimated value of the metals, are found in a recent report by Mr. John A. Agnew on the operations of the Burma Corporation, Ltd., in Upper Burma. In our issue of November 29, 1919, we reviewed the history of this remarkable enterprise. In December 1919 a new company was incorporated at Rangoon with a capitalization of 20,000,000 shares, of 10 rupees each, together with £1,000,000 of 8% convertible stock, the purpose of the latter being to provide funds for the completion within three years of the metallurgical plants, power-projects, and railroad construction necessary to treat 1650 tons of high-grade ore daily. The present earnings of the company are at the rate of £600,000 per year, and since £1,600,000 will suffice to carry out the proposed construction and equipment, it is apparent that before long the current profit should be available for dividends. The decision of the National Mining Corporation to underwrite the stock-issue was based on the report of Mr. Agnew. It is a clear and concise analysis of the resources of the company and of the methods by which it is proposed to exploit them, together with an estimate of the financial results to be expected. Mr. Agnew disclaims any superiority of judgment as to the trend of future prices for metals but presents comprehensive tables showing how the profit will be affected by fluctuations above certain prices which he thinks may safely be assumed as the minimum. These are, lead at £22, spelter at £33, copper at £80, per ton of 2240 pounds, and silver at 40 pence per ounce. In American currency, taking the pound sterling at $4.50, these prices are equivalent to 4.42, 6.63, 16.07 cents per pound, and 75 cents per ounce, respectively. The company has recently acquired a new lease for 30 years from the Indian government on the ten square miles of ground that includes the mine at Bawdwin. The geology of the area is discussed briefly; the statement is frankly made that "it is to be expected that if the ore-channel passes into sediments in depth the orebodies will become restricted in size". This is in accord with experience elsewhere. Thus far, development

has been confined largely to lateral work from the Tiger adit, which is the bottom level, and the two levels immediately above. For the purpose of estimating the ore in reserve, an additional zone only 100 feet in depth is assumed as containing 'probable' ore, although this should not be interpreted as delimiting the orebodies. About 1,600,000 tons of lower-grade ore is proved, but nothing is included in the calculations that does not contain at least 20% of combined lead and zinc. At present the mine is in condition to produce 1500 tons of lead-



zinc ore and 150 tons of copper ore per day, so that development work will be directed mainly to blocking out additional ore while supplying the current needs of the existing plants. The ore itself is a complex mixture of sulphides of lead, zinc, copper, and iron. The silver is associated with the lead and copper, in proportion to these metals and irrespective of the zinc content. The fineness of the particles and the intimacy of the mixture of galena and blende present obstacles to metallurgical treatment. The existing plants include a smelter, which has been treating high-grade lead ore, at Namtu, 13 miles from Bawdwin, since 1911, and a new concentrator, with a present capacity of 800 tons per day, which since being started recently has supplied lead-concentrate instead of raw ore to the smelter. In 1918 Mr. Lawrence Addicks visited Burma as consulting engineer. After a number of possible plans had been considered, it was decided on his recommendation to construct an entirely new and modern smelter near the mill at Namtu, rather than attempt to remodel the old plant, and to build a retort-smelter and sulphuric-acid plant at Jamshedpur, near Calcutta, to treat annually 25,000 tons of zinc-concentrate. The proposed site adjoins the famous plant of the Tata Iron & Steel Co., which will utilize in its galvanizing department a large proportion of the zinc produced. Both these projects are now under way. There is still doubt as to the metallurgical plan to be adopted finally, but the alternatives as stated by Mr. Agnew, and on which he bases three separate estimates of resultant realization, are interesting. The first, a 'foul-smelting' scheme, involves nothing new. The concentrator will produce a zinky lead-concentrate, a zinc-concentrate, and a middling. The first will be smelted for lead, the resulting zinky slag being treated with the middling in a reverberatory furnace, while the zinc-concentrate is sent to the retort-smelter in India. The other schemes provide for two clean concentrates, one of lead and one of zinc, to be made in the mill and sent to the appropriate smelters, while a comparatively large proportion of middling, containing less than 30% lead and 30% zinc, will be treated by either the 'double chloride' or the Elmore process, yielding a lead bullion and a clean, and accordingly desirable, zinc-concentrate for shipment to Jamshedpur. The process would be simplified by making not more than two products in the concentrator in addition to a clean tailing. These would be a high-grade lead-concentrate and a middling, containing nearly all the zinc and some lead, which would then be treated by one of the proposed chemical processes in order to obtain a clean zinc-concentrate for the retort-smelter, besides lead and silver ready for refining. The treatment will probably develop in this direction because it promises profit considerably in excess of that assured by foul smelting. It may be remarked that no electrolytic process is being considered; one reason for this is the lack of an adequate supply of hydro-electric power, although the company will generate a dry-season minimum of 1250 horse-power at Mansaw falls. In addition, a 2500-kilowatt generating station is to be built at Nam Ma, where the company's geologists have discovered a deposit of semi-bituminous coal of good grade. Approximately 7,000,000 tons has already been proved; this will replace the almost exhausted supply of wood for fuel at the smelter as well as operate the steam-electric plant. The development of this coal was one of the factors that determined the selection of Namtu as the site of the new smelter. Thus far the stockholders of the corporation have received no dividends, all the current profit having gone into construction and betterments. This remarkable mine has had the benefit of intelligent engineering and sound financing. There is every reason for believing that Mr. Agnew's calculations, based on the estimates of Mr. R. G. Hall, the resident manager, are conservative and that a profitable future is assured.



Engineering Education

The Editor:

Sir—Acting upon the editorial invitation in your issue of August 14 to discuss engineering education, I submit with much humility my own poor views upon the subject. This apology is necessary because, otherwise, someone might think that I imagine educators reading this letter will be influenced by it, which I don't. (This is nearly as complicated as Harding's front-porch effusions.) Few high-ranking educators will accept your invitation, I think, and discuss the matter freely, because they realize that they disagree markedly among themselves, and it is a mark of honor in the teaching profession to suggest no changes of any importance—merely small fads that don't disturb things too much.

I would summarize my personal views as follows:

(1) A four-year course, as you suggest, is enough. Employers in all lines of engineering prefer a man not too specialized who will adapt his ways to theirs; and, as Dr. Mann in his famous report has pointed out, technical ability is only a small portion of what an employer looks for in the young engineers. Six years gets a student in a rut.

(2) Engineering courses should be less technical and more cultural. This could be gained by eliminating much highly-specialized technique, as now taught, and making courses broader and more leisurely, so that the hard-pressed student could look around a bit and read on his own account. Milo S. Ketchum, from his long experience in engineeirng education, has remarked that the cultural value of a course lies more in the teacher than in the subject matter. For my part, I picked up more culture from a course in steam-engineering given by O. P. Hood than from various courses in English literature and public speaking. However, engineering courses will not be made less technical and more cultural for a long time, because to do so would make it necessary to throw out of their jobs many unchangeable professors who are long on technique and short on culture. O. P. Hood himself left teaching to work for the Bureau of Mines.

(3) Quoting Milo S. Ketchum again, the problems of engineering education will be largely solved when better teachers are secured. Improvement will come not so much by mechanical changes in courses, or new wrinkles in this or that, as by getting capable men to serve as professors with not too much restriction on their individuality. And, of course, they should be well paid. Otherwise professors like O. P. Hood will leave the profession. Again, I do not think this reform will come about, at least for some time. Too many poor teachers are in already, and they protect their interests by keeping capable men out, for which perhaps no one can blame them. Also there is too much machinery, using the word in the figurative sense, in the conduct of the colleges—too much red tape, too much ponderousness to overcome to change anything, too many committees for regulating what generally should be left unregulated in order to give scope for individuality.

Of course, changes will come in engineering education. They are taking place all the time, but they get so compromised and complicated by the time they become effective that they become something else in the meantime.

P. B. McDonald.

New York University, August 19.

Concerning Silver

The Editor:

Sir—Mr. Charles Butters concludes his letter concerning silver, published in your issue of August 7, by saying: "If any reader can tell me on what grounds the Mint can insist on paying for silver deposits in gold when the depositor of bullion asks for silver, I shall be very glad to learn."

Previously, in his letter, he had written: "Now I will tell you just what happens right now, because it happened to me. You go to the Mint with your fine bars and ask them to coin them at the market price. The reply is 'Yes, but we pay you in gold. We are not letting any silver out at present.' We want the silver to get back our reserves'. It is a curious attitude."

In your issue of July 31, I had noticed a 'personal' to the effect that Mr. Butters was on his way here; so, after reading his letter, I called at his office, hoping to have the pleasure of meeting him once more and, incidentally, to inquire if he meant his letter to be taken seriously or whether it was intended to be a sort of pleasantry. Much to my regret, I learned he had remained but a few days and was then in Mexico. Consequently, with your kind permission, I will endeavor to reach him through the medium of your columns.

Perhaps I have missed the real meaning that he intended to convey, but, taking the literal interpretation of the words about his visit to the Mint, I am sure either he did not understand correctly what was said to him about paying gold for fine bars, or else he was misinformed. At present, the Mint does not pay out gold for bars of fine silver. Instead, they are paid for in paper currency or by check (or draft) on the U. S. Treasury; and, in the latter case, which is customary for

larger sums, the word 'silver' is written on one corner of the check as a notice that it has been issued in payment for silver bullion and that it is to be cashed in current funds. Of course, a given amount in current funds has the same exchange value now as a like sum in gold coin. If we were using a silver standard, instead of gold, Mr. Butters could have obtained silver 'dollars' for his bars of fine silver; but who wants "free silver," anyway?

The precise meaning that Mr. Butters wished to convey by saying, "You ask them to coin them at the market price", seems to be very obscure, because silver is not coined at the market price". To illustrate; suppose he took two bars of fine silver, of 1000 ounces each, to the Mint. If they were domestic silver, he would obtain the "market price" of $1 per ounce for them; either in the form of a check or in paper currency, according to his choice, for that is the "market price" paid by the Mint. But, if the Mint coined that quantity (2000 oz.) of fine silver into 'dollars', it would produce 2585.858 (1.292929 × 2000 oz.) such 'dollars'. Therefore, in all probability, he wouldn't expect the Mint to give him that many silver 'dollars' for his 2000 ounces of fine silver, for, by so doing, it would pay him at the rate of $1.29 per ounce, which is the 'Mint price' for silver that Uncle Sam charges the public when he issues silver 'dollars' to it.

With reference to the statement of the Mint employee that "We want the silver to get back our reserve", it is not so very long since Uncle Sam depleted our reserve to the extent of 207,000,000 oz. of fine silver, to obtain which he melted down something like 267,636,363 silver 'dollars', against which, it is quite probable, silver certificates had been issued; and that quantity of silver was just as far removed from the market, while the silver certificates were in use, as it would have been in the form of silver 'dollars' in actual circulation.

To digress for a moment; it may be said that such of our silver 'dollars' as have been issued have been sold to the public at the rate of 30.02 gr. of gold ($1.29), or its equivalent, per ounce of fine silver contained in them. And yet Uncle Sam took many of them away from us, giving us Federal Reserve bank-notes in exchange (Federal Reserve bank-notes not Federal Reserve notes) and then sold this silver abroad at the rate of only 23.22 gr. of gold ($1.00) net per ounce; for which we had paid him 30.02 gr. of gold ($1.29). The difference is 6.8 gr. of gold per ounce, which, multiplied by 207,000,000 oz., equals 1,407,600,000 gr. of gold; or $60,620,000 in round numbers. This will be reverted to, herein, later on.

With reference to that paragraph in Mr. Butters' letter that begins with "If our paternal and non-profit-making Mint buys silver for, say, 90c. per ounce and coins it into silver at anywhere between $1.29 and $1.38", it is probable that he, upon reflecting, will recall that that difference ($1.29 or $1.38 less 90c.) is termed 'seigniorage'. It is really a tax imposed by all gold-standard nations on silver and subsidiary coins. In my communication entitled 'What is a Dollar', which appeared in your issue of August 7, 1915 (a copy of which I gave to Mr. Butters at that time), it was stated, in effect, that, according to a recent article in the local press, the present cost of silver to the Government had averaged 72c. per ounce. Consequently, if the cost was given correctly, the seigniorage (profit) made by the Mint amounted to 57c. per ounce on the silver in the silver dollars and 66c. per ounce on the silver in the subsidiary silver coins. The profit on the 267,636,363 silver 'dollars', alone, would have been nearly $118,000,000. Hence, the term "non-profit-making" doesn't seem to fit the Mint very well when the latter is engaged in turning out silver coins under the conditions that have obtained during the past generation or so.

To digress once more, Uncle Sam, no doubt, intends to be fair to the public, and, as evidence of such intention, he has said he will endeavor to restore to his Treasury reserves a quantity of silver equal to that which he "borrowed" from the public and sold to foreigners to overcome a very trying situation abroad that had been occasioned by the War. Inasmuch as he sold the public's silver dollars at $1 per ounce, and, perhaps, because he wants to encourage some of our home industries, he offers to pay the public $1 per ounce for all it will produce, from home territory, up to 207,000,000 oz. Our production, per annum, has been estimated at about 50,000,000 oz., so the price of $1 per ounce seems to be fixed for a period of about four years. As has been stated previously, the public, presumably, paid a seigniorage tax of about $118,000,000 on the 207,000,000 oz. that Uncle Sam borrowed from it. Just now it seems pertinent to ask if the public does dig up out of the ground, during the next four years or so, 207,000,000 oz. of silver, will Uncle Sam, after buying it at $1, coin it into dollars and sell it back to the public at $1.29 per ounce, thereby making an additional seigniorage profit of more than $60,000,000 on silver coin that, practically, has already cost the public a seigniorage tax of $118,000,000?

The ethics of Uncle Sam's decision to buy domestic silver at $1 per ounce, rather than purchase foreign silver in the marts of the world at a lower price, will admit of debate; and this is particularly true because the producers of domestic silver will sell it to him at $1 per ounce only in case they cannot obtain a higher price for it elsewhere. Still, he can afford to pay $1 per ounce for domestic silver, even if foreign silver is available at a lower price, if he sells it back to the public at $1.29 per ounce, although he would make more if he bought foreign silver at less than $1. Or, if he buys and coins the 207,000,000 oz. into silver 'dollars', issues silver certificates against them, and retires a corresponding amount ($267,636,363) of Federal Reserve bank-notes, will the public be relieved of the additional $60,000,000 seigniorage tax?

Perhaps one of your readers who is experienced in government finance will answer this conundrum. If not, would it be proper to ask Senator Pittman?

W. DeL. BENEDICT.

New York, August 14.

A CORPORATION has been formed in London, according to an article in 'El Economisto', for the placing, in Spanish ports, of stocks of petroleum products. The capital of this corporation is 25,000,000 pesetas (1 peseta = 19.3c., normal exchange), 55% of the stock being held by the 'English Shell' group, the remaining 45% being divided among several Spanish companies in Madrid.

THE BUNKER HILL COMPANY'S OFFICE AT KELLOGG, IDAHO

WARDNER IN 1890

SOME OF THE 'BOYS'

The star marks Fred T. Wilson, the famous scout

THE BUNKER HILL MINE IN 1904

THE BULL-PEN IN 1899

PRISONERS IN THE BULL-PEN DRILLING THEMSELVES

under the leadership of Kennedy, who, later, was shot in a saloon by Dick Adams, a deputy sheriff. The weapons in the hands of the prisoners are made of wood.

RUINS OF THE MILL AFTER IT HAD BEEN DYNAMITED IN 1899

A MOTOR TRUCK HAULING MINE TIMBERS

The Bunker Hill Enterprise—XII

The Human Side of the Business; Labor Troubles; Good Management

By T. A. RICKARD

On September 9, 1919, Mr. Easton and I went up Milo gulch so that I might see the place where the Bunker Hill lode was discovered and get a general idea of the district. This was not my first visit to the locality; I was there in October 1904, on my way from New York as delegate at large to the American Mining Congress at Portland. It was a pleasure to find the mine under the same manager, and, as I said to Mr. Easton laughingly, both looking bigger than ever. Leaving Kellogg, we were soon in the deserted street of the senior settlement, Wardner.

The town of Wardner used to extend for some distance on each side of Milo creek; now it has shrunk to a row of dilapidated and bedraggled houses, most of them untenanted. Those which have disappeared have served for fire-wood and other useful purposes. Their sites and their little 'yards', or gardens, have been re-claimed by Nature. Mr. Easton pointed on the right to the Page hotel, formerly notorious for its wild doings. On both sides of the road are the shells of the 'hurdy-gurdies', 'honky-tonks', dance-halls, and beer-saloons now extinct.

On October 10, 1885, the name of Yreka was given to this mining district, and the town was called Kentuck, but the Post-Office department refused to accept the latter name; so on April 4, 1886, it was changed to Wardner, in honor of Jim Wardner, "a widely known and popular citizen, who did much toward advancing the prosperity of the young but ambitious town". So says the 'History of North Idaho'.

On January 4, 1890, a fire-alarm was followed by the discovery that no water was available; this caused "deepest chagrin", says the chronicler, and compelled "the stricken populace" to fight the flames with snow—successfully, it may be presumed, for the town survived.

On the right is Wardner mountain, in whose rocky depths are the workings of the great mine. Mr. Easton showed me the line of the outcrop, now obscured by the brush that has grown on the rock broken in the course of prospecting. In the gulch is the dump and entrance of the Reed tunnel, the first adit of the Bunker Hill mine and named after Simeon Reed, who bought it from its discoverers. There was the upper terminal of the Bleichert tramway, which crossed the town of Wardner in a 1700-ft. span and in its time was one of the biggest things of its kind. All the old photographs show the tramway, which united the Reed adit with the concentrator that was built near the present mill-site. When the Kellogg adit was completed, in November 1902, the use of the tramway was discontinued. These old workings in Milo gulch are still in use, all the ground above the Reed tunnel being under lease to various parties of 'tributers'. At the time of my visit 80 of these lessees were at work. A million tons of ore has come out of the Reed tunnel. At the entrance is the old candle-house where illuminants were issued to the miners; now the

IN THE COEUR D'ALENE

acetylene lamp is in general use. Thirty years ago a miner required three candles per shift, at a cost of 6 cents apiece; now the carbide used in his lamp costs only 3½c. per shift. The lamp itself costs $1.30 and lasts from two to six months, according to the care it receives. Most of the old Reed mill is dismantled, but out of the remnants a party of lessees has made a rough concentrator and is treating 80 tons per day. Those of us who have been managers of mines know the genus 'tributer', or 'leaser', as he is often incorrectly labeled, and will

appreciate this story: A local soothsayer, called Alexander, was asked by one of them: "Will I make any money out of my lease?" The oracle replied: "If you'll go up there and work steadily, instead of spending so much time in pool-rooms and watching trains come and go, you may make some money, but you certainly won't unless you work". He hit the nail on the head, and his interlocutor hit the trail, it is said.

The Sullivan outcrop, on the left side of the gulch, is now marked by caved workings. In the early days it was supposed to be the best part of the mine. Higher up the gulch are the Stemwinder tunnel and the ruins of another tramway-terminal. Looking back, it is remarkable how little confidence there was in this district even after ten years of productivity. Nobody looked more than five years ahead at the most. Now the miner says to his partners: "O hell! boys, we may as well quit, we can't dig it out". The average man in most mines expects to "dig it out" and anticipates looking for work elsewhere; he is essentially nomadic, and it takes no little self-repression to cause him to settle down like any other respectable citizen.

We climbed to the place of discovery, and, like Kellogg's donkey, surveyed the scene. The outcrop has been mined; in the caved open-cut the hanging wall has fallen, but the foot-wall remains exposed and well defined. That foot-wall has been the theme of much geologizing; it is known now as the Cate fault, after Oscar Cate, a miner. Looking around, it is evident that there was a glade or open space in the forest around the outcrop; here grew the bunch-grass that attracted the historic burro when he strayed up-hill from the gulch. The pinnacle of silvery galena was then, as now, the product of imagination; for Nature has her way of dulling the brilliant minerals of the underworld as soon as they are exposed, by erosion, at the surface. The line of the lode runs diagonally across Wardner mountain, across Milo gulch, and steeply up the other side across the ridge. As far as the eye reaches all is Bunker Hill property, for the company's mineral domain is 4 miles long by 1½ miles wide. On the pitch of the ore-shoot underfoot the distance to the deepest workings is nearly a mile, and down there the showing of ore is better than the one that is supposed to have paralyzed the ass thirty-five years ago.

A hundred yards above the place of discovery, a good miner, Walker Johnson, is opening up a find that was overlooked despite the coming and going of thousands of men during the last thirty years or more. The lode here must resemble that of the original outcrop; not so wide, but similar in character. At the discovery the lode was 100 ft. wide and was stoped for 30 ft., although during the litigation some experts stretched it from the foot-wall over the mountain for half a mile or more. Johnson's find shows a reef or comb of quartzite, darkened by weathering and bearing patches of moss, in which, when broken, are exposed veinlets of bright galena, encased in oxidized mineral. It is a promising apex for a lead mine, for, as already stated, the showing made by lead veins or lodes at surface is rarely alluring. To find the masses of galena that yield profit to the miner, he must dig below grass-roots and beneath the level to which oxidation extends.

Kellogg was named after the discoverer of the lode, as Wardner after its backer; the newer settlement is a great contrast both to Wardner as it is and as it was. As a town, Kellogg dates from July 7, 1893, when the original plat was filed with the auditor of Shoshone county. The 'History' says: "Kellogg has always enjoyed the reputation of a moral town, the first law by the authorities prohibiting a red-light district, and which has since never been permitted to be established. Rev. J. B. Orr, Congregational minister at Wallace, preaches at Kellogg on alternate Sundays." One may ask whether the law or the red-light district was "never established", but one can infer that the Reverend Orr's ministrations were highly effective. As I saw it, Kellogg looked a clean and cheerful town. It extends southward up Milo gulch and westward toward the mills of the Bunker Hill company, so that it is not a town of one straight avenue. The streets are well paved and well kept. In the centre of the town is a monument to Mullan. The inscription is as follows:

CAPT. JOHN MULLAN
TRAIL
1853-1855

Surveyor and Constructor of the military road from Fort Benton, Mont., to Walla Walla, Wash., completed 1862.

Erected under the auspices of the Historical Society of Montana Pioneers. Gift of Wm. A. Clark, Jr. of Butte, Mont., to the city of Kellogg, 1918.

On the granite monument is the figure of Mullan in bas-relief. Standing here one can see the town-hall, a handsome structure of pressed brick, two bank-buildings, two hotels, and two cinemas. The day may come, but not for several decades, when Kellogg will be as Wardner, and eventually both "as one with Nineveh", but we ask the historian of a later day to note the difference between the places of amusement that Wardner boasted as against those of Kellogg. While there I went to one public entertainment, and that was an address on the Constitution by a distinguished local office seeker, it being the day set aside for celebrating that great statement of fundamental principles.

From the centre of the town, one looks up Milo gulch to the wooded hillsides of the Wardner range and westward down the Coeur d'Alene valley to the settlement adjoining the Bunker Hill mills, with the chimney of the smelter appearing above an intervening hill. Northward are the river-flats and more pine-clad ranges.

The community dependent upon the life of the Bunker Hill mine is now so orderly and comfortable that it is difficult to realize what a picture of terrorism it presented 20 years ago. I refer to the strikes of 1892 and 1899, which gave to the Coeur d'Alene a sinister fame. It is necessary to refer to them, not only because of their effects on the Bunker Hill enterprise, but as illustrating the industrial conditions of a former period.

In 1890 a Consolidated Miners' Union was organized in

THE BUNKER HILL MILL AND FLUME IN 1892

THE SECOND MILL AS IT LOOKED IN 1893

the Coeur d'Alene and in 1891 a Mine Owners' Protective Association was formed. In July 1891 the Wardner union presented a demand to Victor M. Clement, manager for the Bunker Hill company, that the arrangement whereby the men paid a dollar per month for medical treatment without hospital facilities should cease, and that the same amount be deducted from each man's pay in behalf of the Central Miners' Union Hospital at Wallace. Early in August the manager replied by calling an election for choosing between three propositions: (1) to continue the existing arrangement; (2) to build a new hospital on the company's ground, the company to give the site and the lumber, on the condition that sufficient money was subscribed to pay all other expenses; (3) exemption from hospital taxation of the men signing a contract releasing the company from all liability for sickness or injury during their employ. Only a few men voted, and most of these favored the erection of a hospital at Wardner. The company gave notice of its intention to continue the dollar per month deduction for medical treatment and invited those who objected to 'get their time'. A strike followed. Sundry outrages were perpetrated. The strike ended, by compromise, in December. Other disagreements ensued at other mines in the Coeur d'Alene and as these synchronized with a dispute with the railroad companies over freight-rates, all the principal mines were closed down by January 15, 1892. In March it was announced by the Mine Owners' Association that satisfactory arrangements had been made with the railroads and that the mines would resume work, but only $3 per day would be paid to car-men and shovelers, as against $3.50 per shift of 10 hours to all miners.

In the statement published by the Mine Owners' Association, it was said:

"This scale of wages, after much consideration, has been determined upon as liberal and fair by the Association and it is hoped that it may meet the approval of all old employees as well as the public generally. The Association also announces that in all tunnel mines where a majority of the men desire to avoid working Sunday and Sunday night they may, on giving expression of such desire to the manager, have Sunday and Sunday night off each week.

"While we have no objections to miners' unions if they are governed and conducted by able, sensible, real miners, it is nevertheless a fact that during the years we have had unions in this country there has been trouble somewhere most of the time, strikes and threats of strikes, committees and delegations continually, to the great annoyance and loss not only to the miners but also to the community generally as well as to the mine-owners, and we challenge anybody to show in what manner the miners or owners or the community have been benefited one cent's worth for all the trouble caused, for all the time lost, for all the hard feelings engendered, for the many hard-earned dollars which the working miners have contributed to the coffers of the unions, excepting in the matter of the Sisters Hospital, which is a notable institution and worthy of generous support . . .

"The only men who can be said to have been benefited at all are the car-men and shovelers, worthy men, no doubt, but it is well known that any reasonably intelligent man can learn to do this work in tunnel mines in a few days, and can it be said that these men are entitled to the same pay as skilled miners, who have spent years in learning their trade? We have endeavored many times to learn by what reason the unions demand the same pay for these men that they do for miners, but have failed entirely to get any good reason . . . Even admitting that the danger is equal to both miners and car-men alike, we would ask if the world's work is paid for without regard to skill? Does the locomotive fire-man get the same pay as the engineer? . . .

"It is true that the mine-owners raised the wages of car-men and shovelers last year at the demand of the unions, but they did so under protest and with a keen sense of its injustice. However, at that time lead and silver were much higher than at present, and desiring to get along amicably with the unions and being able to afford it, the wages of car-men and shovelers were raised. Now the conditions have changed; lead is only four cents and tending downward. Silver is below 90 and going lower, and the mine-owners are therefore under the necessity of the strictest economy."

I would like to quote *in extenso,* but space forbids. The pronunciamento proceeds to say that it is entirely a matter of business, that the ores are low-grade, and that strict economy is imperative. Moreover the capitalist followed the prospector into the region, and with the money and skill of the capitalist the mines were developed and equipped. Why then these threats to run them out of the country, to burn their mills, blow up their flumes, and even murder them? Does this talk of riot and murder do anybody any good? Who are the cause of it? A few agitators, not real miners, who terrorize the community, "their sole purpose being to keep up a continuous state of turmoil and strife to the end that tribute may in some way or another come to them".

Then the unions are warned by the mine-owners that any losses due to the destruction of mills or other property will have to be paid by the county. They seem to anticipate events. They expect that any concession will be followed by fresh demands. They say:

"We would ask if many of the leaders have not made up their minds that if they are successful in the present conflict, they will within 60 days urge a strike for $4 a day for miners, for the closing of company boarding-houses, for a boycott on all business enterprises in which any mine-owner has an interest, for a rule that no miner will be allowed to work in any mine in the Coeur d'Alenes over seven days unless he joins the union, if not freely then by force, that no mine foreman shall discharge any man underground until he has given a satisfactory reason for so doing to the union."

Again it is evident that the mine-owners anticipate the union program with considerable accuracy. Their statement is long and discursive; it shows how warm the controversy has already become, for it mentions all those causes of trouble with which we are now familiar. It was not a fight between employer and employee, but be-

tween the owners of the mines and a group of agitators from the outside. The statement concludes by saying:

"We will simply add that we have determined that the wages cited are fair and liberal, and all we ought to be asked to pay, and having so determined we do not mean to start up our mines at any higher wages. We will wait until the first of April for our men to make up their minds, and if they decline to accept, we will have no other course but to claim the right to work our mines (which we paid for and own) outside of any unions, and we are fully determined to do so without any dictations from any association, conceding, however, the right to every person to demand any price they see fit for their labor as long as they do not interfere with the rights of others, and we feel confident the law will uphold us in so doing."

To this the Central Miners' Union of the Coeur d'Alene replied immediately, in terms that indicated the impending struggle. The spirit of the reply is suggested by the opening paragraph:

"As miners, we are not gifted with the literary abilities of the hired attorneys of the Mine Owners' Association, nor at the same time with the talent of making statements so absurd and false as to cause a blush of apology on the cheeks of Ananias, but as working-men we ask a thoughtful and considerate public to view both sides of the question before forming an opinion as to the merits or demerits of the case brought before their notice."

As a critic, I would say that the statements of the two parties do not differ greatly in literary style, and it is a safe guess that both of them were prepared by "hired attorneys". The Unions assert that "the late shutdown" was not due to wages but was intended "to crush out organized labor" and to introduce contract labor. They insist that the owners have made big earnings on their capital, except where the mines have been mismanaged. They complain of the condition of the lodging-houses and the quality of the board provided by the companies. They deny that the increased rate to the carmen was made under protest and that in certain mines the higher rate had been paid previously without the solicitation of the miners' union. They proceed to say:

"The Mine Owners' Association conveys the idea that we are nothing more nor less than a band of anarchists continually threatening the destruction of life and property, liable at any moment to carry out such threats if necessary to accomplish our purpose."

They ask where and by whom were such threats made? The history of succeeding events records the fact that the mine-owners were better prophets than managers and that the Union fulfilled the worst anticipations of its opponents.

The question uppermost in strikes is touched:

"There is no doubt that the mine-owners would not object to the unions provided they were officered by their nominees, but to this every member objects, as they should, in order to maintain some independence that in future as in the past they might be in a position to direct their efforts to mutually benefit all working-men and by lawful means, and to state that the central or any other local union means in the future to select a county ticket to be voted on in the fall is a falsehood without a vestige of truth. . . . As for coercion in order to enlist members, the people here know well we have never used the like with one-half the force the Association has done to compel outside mines to fall in line. Will the Mine Owners' Association allow their constitution to be perused by the public? We think not, because from information now in our hands we know it is so opposed to law and

THE OLD REED MILL

order that the darkened archives of the Association is its safest retreat."

The proposal of the mine-owners was rejected; the mines were closed down and notice was given that new arrangements would be made to re-open them for work on June 1 (1892). Before that date the managers began to import miners from the outside under the guard of detectives. They also obtained injunctions from the Federal court, and served them on a number of persons, restraining them from interference with the operation of the mines. During June the mines were run short-handed and intermittently, chiefly by non-union labor. The 'History of North Idaho' says:

"The mines that came under the special displeasure of the union men were the Bunker Hill & Sullivan, at Wardner, and the Gem and Frisco, on Canyon creek. At the Canyon creek mines the feeling between the union strikers and the non-union men who had taken their

places and were working under guard was very bitter. Exchanges of harsh words were frequent and fist-fights were not uncommon. These eventually precipitated an armed encounter on July 11th between union men and the employees and guards of the Frisco mine. At about five o'clock in the morning of that day the firing commenced. It is said by both sides that the shooting was not intended at first to do other execution than to frighten the men out of the mine. Soon, however, a pitched battle resulted, both miners and guards firing to kill. The strikers were at a disadvantage, so withdrew up the hills. It was now that the plan of destroying the mills took shape in their minds. They came to the end of the tramway, placed some giant powder in a car and started it to the buildings on its errand of destruction. The fuse was too short, so the explosion took place too soon to do serious damage, though the tramway was destroyed. Powder was then carried to the flume and, the water having been turned off, sent down the penstock and to the water-wheel. The old mill was thus wrecked, for fortunately most of the men had withdrawn to the new mill, thus saving their lives. The men in the mill continued firing a short time, but soon realizing their hopeless position, surrendered.

"Soon the battle began at the Gem. The men in that mine had made some preparation by erecting barricades of wood and lumber. As the night shift was going off and the day force going on, the firing began. After a large number of shots had been exchanged by the strikers in the town of Gem and the men at the mine, a conference was held under a flag of truce, in which it was agreed that the non-union men should surrender if so advised by A. L. Gross, the only member of the Gem company in the country. Gross advised the surrender and the men handed over their arms.

"In the two battles two non-union men were killed, namely John Starlick and Ivery Bean, also three strikers, James Henessy, Gus Carlson, and Harry Cummings. A considerable number were wounded.

"After their victories at the Gem and the Frisco the strikers proceeded to Wardner, going from a point outside of Wallace to the junction in two freight-cars propelled by gravity. They arrived after dark on the night of the 11th, took possession of the Bunker Hill concentrator and placed a ton of powder under it. Next morning Mr. Clement had the choice of discharging his non-union employees and sending them out of the country or having his mill blown to pieces. Under the circumstances he agreed to send the men away, which was done.

"Many of the non-union men left the country July 12th, going by rail to the Mission and arriving at that point about three o'clock. The steamer was transferring troops across the lake and did not reach the Mission until one o'clock next morning. While waiting, the non-union men were made the victims of an outrage which has been condemned by both parties to the quarrel as a dastardly and utterly inexcusable affair. Persons whose identity is unknown to the writer and perhaps not known with certainty by many outside of their own number, came down on a hand car to the Mission and attacked the unarmed men with guns. The men fled, of course. They were pursued by the attacking party over the meadow toward Fourth of July canyon, six miles distant, and all of them subjected to the hardship of spending a night in various hiding-places. Those who took refuge along the banks of the river either made their way back to the Mission in small boats or were picked up by the steamer next morning. From the number missing it was supposed that many had been killed, but no bodies were found, although diligent search was made for them. At least one man, John H. Abbott, was severely wounded in the left breast by a bullet, so that he was not expected to recover, but we are informed that he eventually did. The purpose of the attack was doubtless robbery rather than bloodshed. Many of the victims had everything in the world that they possessed taken from them. It should be added that the miners' union of the Coeur d'Alene emphatically denied that it or any of its members had anything to do with this outrage, directly or indirectly.

"Martial law was promptly declared, and under the protection of the soldiers many of the expelled non-union men returned. With such help, the Bunker Hill & Sullivan resumed work before July 1. Many of those who were most active in the uprising were compelled to flee from the country; many others were placed under arrest, but only a comparatively few were convicted and punished. Twenty-five were tried in the Federal court on a charge of violating the restraining order, and of these Thomas O'Brien was sentenced to eight months and F. T. Dean, R. M. Boyce, Thomas Henney, and Thomas Doyle to six months imprisonment. A number were tried at Coeur d'Alene City for conspiracy and four were sentenced to the House of Correction at Detroit, Michigan; George A. Pettibone for two years, M. L. Devine and Charles St. Clair for 18 months, and John Murphy for 15 months. Gradually the troops were removed, and on November 18, 1892, martial law was revoked."

It is a miserable story. Even the shooting was poor! Think of all the gun-play that took place at the Gem and Frisco mines, yet only five men were killed. A side-light on these events is afforded by Charles A. Siringo, a detective engaged by the Mine Owners' Association. In his book, 'A Cowboy Detective', published in 1912, he relates his experiences during this strike. Acting under instructions, he played the part of a miner and joined the union at Gem. His reports were mailed to St. Paul, Minnesota, where a copy was made and sent to the secretary of the Mine Owners' Association at Wallace. Siringo, or 'Allison', as he then called himself, was elected secretary of the union; whereupon he did the correct thing, shirked work, and was discharged. In order to remain secretary, he pretended that his father sent him money from Texas. The treasurer of his union was George A. Pettibone, a justice of the peace, mentioned among those who were punished for their crimes. With Pettibone and other union men he would order 'scabs', that is, those refusing to join the union, out of the country and, if necessary, "get up a mob, by holding a citizens mass-meeting, to run them out of the State". Only

members of the union were permitted to enter the "citizens' meeting". He describes the sequel:

"Then it would be declared the sense of the citizens' indignation meeting that certain 'scabs' be run out of the State. Often as many as half a dozen 'scabs' would be taken from their homes, sometimes with weeping wives and children begging for mercy, and with tin pans and the music of bells, they would be marched up and down the street to be spit upon and branded as 'scabs' before the public eye. Then half-clothed and without food, the poor devils would be marched up the canyon, a few miles beyond Burke, and told to hit the road. Pistols would be fired over their heads to give them a good running start. By this route, during winter, the snow is waist deep over the Bitter Root range, and there is not a living inhabitant until reaching Thompson's Falls, Montana, a distance of about 30 miles. This thing was kept up all winter, and I learned a few new lessons in human nature." His reference is to the winter of 1891-'92.

When war was declared between the mine-owners and the unions in the spring of 1893, the sheriff of the county was friendly to the unions, as Allison informed his employers, so that a trainload of strike-breakers passed through Wallace without stopping, thereby eluding the sheriff, who stood ready to arrest them under the State law against importing armed thugs. Each side invoked the law and both sides broke it. It was a lawless fight, a reversion to frontier lawlessness. Other trainloads of strike-breakers were imported under armed guards. It became evident that the secrets of the Gem union were being given away by a traitor, so a Butte detective was put to work to spot him, and Mr. Allison's job became uncomfortable. He was charged with disloyalty at a meeting called for the purpose, but managed to bluff his accusers. Two days later he had reason to believe that he had been recognized by a man whom he had helped to convict in Nevada. It was time to skip. He hid under the sidewalk, and while there saw some of the fighting and heard the explosion at the Frisco mill. Crawling under the sidewalk, he escaped, while angry men on top were discussing what they would do to him. He makes a good story of it. A few days later he was kept busy identifying the union leaders, who were arrested by the troops under General Carlin and placed in the 'bull-pen', a large stockade with a frame building in which the prisoners slept and ate. In less than a week 300 were in the 'bull-pen', which was at Wardner. Our author, the detective, concludes his description of his experience thus:

"The Coeur d'Alene trouble had been caused through the miners' union wanting to dictate as to how the mines should be run. When they made a demand for shorter hours, and that 'muckers' and common roustabouts receive $3.50 per day, the same wages as skilled miners, the mine-owners closed down the mines and sent out for non-union men."

Work at the mines was resumed, the bad men were arrested or driven out of the district, and order was restored, but the feeling of bitter antagonism survived between union and non-union labor. Several outrages were committed, one of the worst being the murder of John Kneebone in July 1894 and the expulsion by force out of the county of R. K. Neill and three other men. On April 23, 1899, a demand was made on the Bunker Hill company by the Wardner union for a uniform wage of $3.50 to all underground men and for the recognition of the union, now organized with the Western Federation of Miners. The manager, Frederick Burbidge, said he would submit the matter to the other officers of the company; they agreed to increase wages of all laborers from $2.50 to $3 and of all miners from $3 to $3.50 per day, but refused to recognize the union. On April 26 the tramway was seized by a group of armed strikers and men were stopped from going to work.

On April 29 a group of masked men at Gem took pos-

'OLD GLORY' ASSERTING THE RESTORATION OF LAW AND ORDER; JULY 1, 1899

session of a train from Burke, they compelled the engineer to back the train to the powder-house at the Frisco mine, where 70 boxes of dynamite were loaded on a box-car. The train then went to Wallace. There a number of men from Mullan got on board. Proceeding to within a mile of Wardner, the engineer was compelled to stop the train while another group of men boarded it. By this time the mob on the train numbered about a thousand, of whom 300 were masked and armed. They left the train and went to the Bunker Hill mill, which was then completely destroyed by the use of several hundred pounds of dynamite.

As soon as the echoes of the explosion had died away among the surrounding mountains, an ominous silence

ensued, to be broken by a deafening fusillade from the train, this being meant to celebrate the 'victory' of the ruffians posing as labor reformers.

Nobody was killed at the mill, but during the excitement that followed John Smythe, a Frisco miner, was shot and killed; James Cheyne, a vanner-tender of the mill, was fatally wounded; and R. R. Rogers, stenographer with the Bunker Hill company, was wounded. Smythe is said to have been killed by the strikers because he was suspected of being a 'traitor'; for the killing of Cheyne a man named Corcoran was convicted and sentenced to 17 years imprisonment.

Those were bad days for the staff at the Bunker Hill. Wisely, they did not meet violence with more violence, for that would have settled nothing. Friends came from Gem to warn them of the impending danger; they were told that 500 men had stolen a train, opened the Frisco powder-house, broken into militia headquarters and seized rifles, and were coming down to blow up the mill. Word was passed for everybody to abandon the property and seek safety. Mr. Clark tells me that after he had seen "the mill go up" he noted the sun glistening on the dinner-buckets of a group of men on the hillside coming down from the mine toward Government gulch, so as to avoid Wardner. Mr. Burch was with them. The whole party walked to the mouth of Pine creek, where they camped. J. C. Bodley, an old-timer, made 'biscuits' for them that night. They waited until 11 p.m., when a special train sent by the president of the company, Mr. Bradley, came up from Tekoa. At Cataldo they picked up Mr. Burbidge, who had escaped over the river flats. On arrival at Tekoa, at 5 a.m. next day, they breakfasted, and four hours later took the train back to Kellogg, where they found that the strikers had gone and everything was quiet. The Kellogg adit was being driven at that time and the management was anxious not to suspend this particular work, so, as the power-plant had been destroyed, the old plant in Milo gulch was brought into use and an Edison bi-polar dynamo was installed for driving the cars in the adit. Lights from the same dynamo were used to illuminate the bull-pen at Kellogg, where 500 men were imprisoned all summer. This is the second mention of a 'bull-pen'. Again United States troops were sent into the district, on appeal from the Governor of the State. General H. C. Merriam was in command. He 'rounded up' those suspected of complicity in the destruction of the mill and placed them in the bull-pen. Most of those charged with major offenses escaped and those charged with minor offenses were released, because the County declared itself unable to try so many persons. Owing to complaints made against the harshness with which the prisoners were treated, the matter was referred by Congress, on January 8, 1900, to an investigation by the Committee on Military Affairs. It was charged that there was issued and enforced by General Merriam a proclamation in violation of the Constitution of the United States and of the State of Idaho. It reads as follows:

"Whereas the following notice has been served upon the mine-owners of Shoshone county by the duly constituted State authorities, by whom martial law has been declared, to-wit:

"To the mine-owners of Shoshone county:

"Certain organizations or combinations existing in Shoshone county have shown themselves to be criminal in purpose, inciting and, as organizations, procuring property to be destroyed and murders to be committed, by reason whereof it has been twice necessary to declare martial law in Shoshone county.

"You are therefore notified that the employment of men belonging to said or other criminal organizations during the continuance of martial law must cease. In case this direction is not observed your mines will be closed."

The effect of this proclamation, of course, was to prevent union men from obtaining work in the county, whereupon the authorities, civil and military, were charged with "an outrageous misuse of the military power of the United States . . . in the interest of the owners of the Bunker Hill and Sullivan mines." After an investigation that lasted three months, the committee reported that none of the 'whereases' were sustained by the evidence, but a minority of seven condemned the action of the President, the Governor, and the General.

The trouble-makers were scattered effectively and normal conditions of production were restored by the end of the year.

Another incident needs to be recorded. The Western Federation of Miners, an organization at that time dominated by criminals masquerading as labor-leaders, bore a grudge against Mr. Bradley, as the president of the Bunker Hill company. So they told one of their number to assassinate him. The story is told in the 'Confessions of Harry Orchard', published in 1907. Horsley, *alias* Hogan, *alias* Orchard, assassinated Frank Steunenberg, former Governor of Idaho, on December 31, 1905. While in prison at Boisé, during 1906, he wrote the 'Confessions'. One chapter is entitled 'How I went to San Francisco and Blew up Fred Bradley'. It appears that in August 1904, W. D. Haywood, secretary-treasurer of the Western Federation of Miners, and George A. Pettibone, who was sentenced for two years on account of his doings in the first Coeur d'Alene strike, arranged with Orchard, at a meeting in Denver, "to put Fred Bradley out of the way". Orchard proceeded to San Francisco and prepared for the crime. Pettibone sent him $100 each month. He had brought 10 pounds of dynamite for making a bomb and engaged a room a few doors from Mr. Bradley's home on the corner of Leavenworth and Washington streets. Mr. Bradley was in Alaska when he arrived, so Orchard waited until his return to San Francisco in October. He watched for him "with a shotgun loaded with buck-shot, and tried to catch him coming home at night; but it was not light enough to tell him from the rest" of the people living in the flats in which Mr. Bradley resided. So he put strychnine in the bottles left by the milkman in the early morning. He says: "I figured the girls [the servants] would serve Mr. and

Mrs. Bradley's breakfast first and they would get the poison first". He had made the acquaintance of the servants while spying about the place. It happened fortunately that the cook had occasion to taste the milk, found it bitter, and informed Mrs. Bradley, who sent out for a fresh supply. So this diabolical plot miscarried. Next he prepared his bomb. "I bought a piece of five-inch lead pipe about a foot long at a plumber's," he says, "and put wooden ends in it. Then I hammered one side of it flat, so it would lie straight without turning over, and I cut a piece out of the other side, and turned back the flap and fastened a little vial on this, so that when you filled it with sulphuric acid, and you pulled out the cork, the acid would run out into the hole in the pipe. Then I filled up the lead pipe with about five or six pounds of No. 1 gelatin, and put some caps and sugar and potash on top of this and opposite the hole in the lead pipe, so the acid would fall on them. Then I planned to hitch a little string to the cork of the bottle, and fasten the other end of the string in a screw-eye in a door, so when you opened the door it would pull out the cork and set off the bomb."

He practised with it in his room, omitting the cap and acid, until he felt sure it would work. He noted Mr. Bradley's habits and decided to "get him" as he came down after breakfast on his way to his office. In order to make certain, he telephoned to Mr. Bradley, posing as a miner from Goldfield, Nevada, and made an appointment with him at nine o'clock in the morning at his office. On November 17, 1904, he placed the bomb on the stairway, so that the opening of the door would cause it to explode. He left his room and wandered about the town, waiting to read in the evening paper how well he had succeeded in his foul deed. In due course he read an account of the explosion and that if Mr. Bradley did not die, he would lose both hearing and sight. The explosion was imputed to the leaking of gas and the Pacific Gas & Electric Co. actually had to pay $10,000 damages to the owner of the flats, after a lawsuit that went as far as the Supreme Court.

The stairway and entrance were blown to pieces and Mr. Bradley was hurled into the street, badly injured, of course, but, most fortunately, the first fear of a loss of sight and of hearing proved wrong, and he was himself again within a few months. On arrival at Denver, says Orchard, "Pettibone was well pleased with the news, but said it was hard luck that it did not kill him". Orchard is still in jail, for, on account of giving evidence against his associates, he was not hanged. Haywood has continued in his career and is now again in jail, as a leader of the I. W. W. One of the features of the murders and assassinations perpetrated in the name of a false kind of labor unionism is the repeated re-appearance of the same criminals as the agents of disorder and crime in various mining districts and the apparent failure of the law to discipline them. Even public opinion has failed to stimulate the officers of the law to the proper protection of the community.

(To be Continued)

Determination of Molybdenum

The Bureau of Mines has recently issued Technical Paper 230, 'Determination of Molybdenum', by J. P. Bonardi and E. P. Barrett. This report presents the results of an investigation by the Bureau on methods of analysis for determining this metal. During the recent activity in the molybdenum market the old and well-known methods for the determination of molybdenum in ores were found inadequate. They were satisfactory for high-grade material, but, on account of the advent of flotation methods and the inflation of the market because of the War, the grade of products became so low that the molybdenum content needed to be determined to the second decimal place.

The Bureau, therefore, began an investigation to devise a more accurate method for determining molybdenum in low-grade ores. The results of the first efforts disclosed the fact that the required degree of accuracy was difficult to obtain by the various methods in use. The method used must be rapid as well as accurate, as a company treating a low-grade ore must know the results not later than the day after the samples are taken in order to control closely the mining of the ore as well as the operations of the milling plant.

Some of the quantitative methods for the determination of molybdenum that are in general use are as follows: (1) Precipitation as the sulphide from acid or alkaline solutions with or without increased pressure; (2) precipitation as mercurous molybdate; (3) precipitation as lead molybdate; (4) titration with lead acetate; (5) titration with potassium permanganate; (6) titration with titanium chloride; (7) the iodometric method; and (8) titration with potassium iodate.

Of these methods, that of reduction of the molybdenum and titration with potassium permanganate proved the most suitable for rapid accurate determinations on low-grade ores. The ore is decomposed either by acid or by fusion with sodium peroxide into a soluble molybdate and insoluble compounds of the other constituents of the ore. The molybdate is filtered, acid added, and the solution is passed through a Jones reductor where the MoO_3 is reduced to Mo_2O_3. The solution is then titrated with potassium permanganate and the percentage of molybdenum present is calculated. Successful use of the method, however, requires close attention to details of procedure as outlined in the report. Gravimetric determination of molybdenum by precipitating and weighing as lead molybdate is rapid and accurate, but certain precautions must be observed. In this method the ore is decomposed with acids and treated with ammonium hydroxide to form ammonium molybdate. From the hot solution the molybdenum is precipitated as lead molybdate by adding lead acetate solution, 2 or 3 cc. in excess, heating the mixture a few minutes, and filtering. The precipitated lead molybdate is then ignited, cooled, weighed, and the weight of molybdenum is calculated. A copy of the pamphlet detailing the procedure may be obtained from the Bureau at Washington.

Metal Mining in California

The conditions in the metal-mining industries in California during the first half of 1920 were even more burdensome to the operators than in 1919. The high cost of supplies and labor and the scarcity of skilled labor have increased the number of mines that have suspended or curtailed operations and have materially lessened the output of metals, according to C. G. Yale, of the U. S. Geological Survey.

During the first six months of 1920 the U. S. Mint and local smelters and refiners, to which most of the newly mined gold from California is sent, received from the mines of the State $7,811,390 in gold, or $1,086,739 less than during the first six months of 1919.

In 1918 there was a decrease in the production of gold in California, compared with 1917, of more than $3,500,000, but in 1919, with an estimated production of $17,380,000, there was an increase of $852,000 over 1918, which showed some progress toward the recovery of a normal output. However, if the monthly receipts at the mints, smelters, and refineries for the last six months of 1920 continue at the same rate as in the first six months, the total output of gold in California in 1920 should be $15,622,000, or $1,757,000 less than in 1919.

The silver received during the first half of 1920 by the mints, smelters, and refineries amounted to 503,794 oz., 376,310 oz. more than in the first half of 1919. This abnormal increase in the output of silver is due entirely to operations at a new silver mine discovered in 1919 in San Bernardino county, just over the border of Kern county. Most of the silver heretofore mined in California has been obtained as a by-product in the mining of gold, copper, and lead ores, for few purely silver mines have been operated in the State. During the last year, however, a number of old silver mines, most of them in Inyo and San Bernardino counties, have been re-opened, owing to the high price of the metal.

The loss in the output of gold is caused by curtailment in the operations in certain large mines on the Mother Lode and elsewhere and by stoppage of work on a large number of mines. Many properties that were worked profitably under normal conditions continue to be operated at a loss. Once shut-down and filled with water, such mines may never be re-opened. Two of the most productive mines of the Mother Lode, with workings extending vertically below 4000 ft., had to be flooded to extinguish disastrous fires, and now hard and expensive work is being done to unwater them. On the Mother Lode five or six years ago a profit could be made on ore that yielded $3.50 per ton, but now nothing can safely be classed as ore which contains less than $6 per ton. Not only the quartz but the placer field is affected. Six years ago one large dredging company, handling about 36,000,000 tons of gravel yearly, worked 14 dredges, which dug up $2,637,700 in gold at a cost of $15 per ounce. In 1919 it worked 11 dredges, and the gold output of $1,840,000 cost $23 per ounce. It is found less expensive, however, to sustain the loss than to close down the plant, for the loss through taxes, insurance, deterioration of equipment, and breaking up of organization would be greater.

At Grass Valley, the most productive quartz-mining district in the State, the larger mines are severely affected by a shortage of skilled miners, for higher wages in lumber-camps and shipyards have induced many men to give up mining. The Empire mine, the most productive deep gold mine in the State, has made extensive improvements in 1920. The North Star mine continues production but at a less rate than during normal times. At Jackson and Sutter Creek, Amador county, the most productive district in the Mother Lode, the principal producers have made little output this year, owing to the necessity of unwatering the mines after flooding them to extinguish fire. The highly productive activities of the recently re-opened Morgan mine, Calaveras county, are noteworthy.

Shortage of water throughout the hydraulic-mining regions in Sierra, Plumas, Siskiyou, Trinity, and other counties, where this class of work is carried on, has greatly reduced the production of placer gold. Drift-mining has also languished, and no new properties of note have been opened. The dredge-mining industry has propably suffered less than other gold-producing operations, yet skilled labor has been scarce and costs have been greater, and reduced prices have materially lessened output and profits.

Copper mining in California has not been in good condition this year. What was formerly the largest producer, the Mammoth, in Shasta county, continues closed down and other large mines are idle. The Mountain Copper Co., at Keswick, started work again this year in its Iron Mountain and Hornet mines and is reducing its ore at the smelters on San Francisco bay. Operations have been curtailed at the mines of both the Calaveras Copper and the Penn Mining companies, in Calaveras county. Plumas is now the most productive copper-mining county in the State. The principal mines, the Engels and the Walker, continue operations and have made many permanent improvements at their plants. The Cerro Gordo mine, near Keeler, the largest producer of lead-zinc ores, has again been started, and ore is being shipped by the Rip Van Winkle, Lucky Jim, Utacala, Sterling, and other mines around Darwin. Most of the zinc mined in California in 1920 will come from these southern counties, as very little has been produced in Shasta county.

The highest grade pumice at present mined is of Italian origin. The seat of the industry is the volcanic island of Lipari, one of the group lying off the north coast of Sicily about 40 miles from the Italian mainland. The methods employed in mining are primitive. The deposits for the most part are found near the surface, and the material is extracted by drifts driven only a few yards into the hillsides. The output could be increased if these drifts were properly timbered so as to follow up the profitable strata. Without support the danger of caving necessitates the abandonment of the drifts before they are worked out.

Conditions in Mexico

By An Occasional Correspondent

The Mexico City version of the early history of General Pablo Gonzales, reported in my July letter, I have recently found to be incorrect. Don Pablo did not reside in the United States as a youth nor did he marry an American wife; his knowledge of English was acquired by residence on the Mexican side of the Texas border, and when Carranza revolted against Huerta in 1913, the future presidential candidate was merely a book-keeper in the flour-mill of his German father-in-law at Monclova, the State capital where Carranza was governor. All of which is a preliminary for giving a final farewell to Don Pablo as a public character of note.

Even though Don Pablo's desertion of Carranza was

ON THE TRAIL

the main cause of Obregon's quick and easy victory over the Government, the entrance of the victorious rivals into Mexico City in May as friends seemed to offer little hope of permanent peace between them. Everyone was therefore relieved, as well as surprised, when Don Pablo soon announced in the papers the withdrawal of his presidential candidacy for patriotic reasons. The real reason, however, was fear of Obregon, who had packed Mexico City with 30,000 devoted troops, drawn from his Sonorans and the Zapatista hordes, and had then proceeded to notify Don Pablo that it was now a case of 'fight or get out of the ring'. While Don Pablo—luckily for the public—proved a coward, some of his friends were more pugnacious, so that the rebellion of various lesser generals soon ensued. Among the latter were Jesus M. Guajardo, who earned his high rank last year by slaying the famous Zapata; Carlos Osuna, once a Protestant preacher and lately governor of Tamaulipas; Espinasa Mireles, the governor of Coahuila; Lucio Blanco, who in 1914 was recreant to his trust as Carranzista governor of Mexico City; Ricardo Gonzales; and Ironeo Villareal.

However, the campaign of these rebels against the new government were of short duration, as they foolishly started operations in the deserts on the Rio Grande border, where, lacking control of the railways, they were unable even to feed their troops, much less keep up a supply of munitions. Osuna was soon defeated and fled with a few followers into the mountains. Blanco and Mireles, after a few reverses, escaped into Texas. Meanwhile Gonzales and Villareal were fighting between Laredo and Monterrey, and happened to attack the latter city while Pablo Gonzales was visiting there. On this suspicious coincidence, the Government ordered the immediate arrest of Don Pablo and his gang, but while the generals José E. Santos, lately governor of Nuevo Leon, and Carlos Garcia, chief of staff, were soon found and jailed, the king-pin himself was only discovered after a long search and was then found concealed in the chimney of his cellar. About this time, General Guajardo was also captured in Monterrey, having entered the city in disguise in order to obtain recruits and supplies. The unlucky Guajardo was at once tried and shot, on July 19, as a spy; and many, remembering the usual fate of Carranza's opponents under like circumstances, expected a tragic sequel also to the court-martial handling the case of Don Pablo. Nevertheless the court, being given a free hand by the Government, found no evidence implicating the latter in the sedition of his subordinate generals and were therefore obliged to release him. This unexpected denouement produced an excellent impression everywhere and probably had much to do with the surprising fact, reported by the Minister of War on August 1, that not a shot had been fired by the Federal army against rebels anywhere during the previous week.

While it requires skilled diplomacy to get a Mexican rebel to surrender, it often requires even more to keep him peaceful. For instance, the Zapatista general, Genevevo de la O, who in May had accompanied Obregon on his triumphant entry into Mexico City, became surly on his forced retirement to Cuernavaca in June, and was only restored to good humor by being allowed to name the governor of Morelos. As the generals Gildardo Magaña, successor of Zapata as chief of the Liberating Army of the South, Valentin Reyes, and Everardo Gonzales had joined Obregon at the same time as Genevevo, the surrender in July of the generals Saveedra and Mendoza signified the practical finish of Zapatism as a rebellious political movement.

In Puebla, the notorious brigand Higineo Aguilar, who has been in arms against all the various Federal regimes since 1909, has tendered his submission; and this means

the possibility of again resuming mining in the South, distracted since 1914. A strong argument for the fatalist view of life might be found in the case of General Meixueiro of Oaxaca, who, active in arms against Carranza for five years past, died last month quietly in his bed within a few weeks of his reconciliation with the Government. In July the rebel bands of Chiapas and Tabasco also submitted, and the generals, Manuel Larraga and Leon Martinez, who had plagued the State of San Louis Potosi. Even distant Sonora has its tale of pacification, for some of the Yaqui tribes, in revolt since the Diaz epoch, after a severe defeat administered to them in April at Bacatete by the army of General Elias Calles decided to lay down their arms.

What seems almost too good to be true is the expected speedy rendition of Pancho Villa in accordance with a contract just drawn up between him and a Federal envoy. In return for his submission, Villa is to be given the ranch of El Canutillo in Durango and provided with an operating force of fifty of his friends, whose wages will be paid by the War Ministry. Those of his troops who desire to do so, will be incorporated into the Federal army, the remainder will be mustered out with a year's salary as a present, and each man given sufficient land to start a farm of his own. The cessation of Villa's brigandage will be an inestimable boon to American mining enterprise; indeed, as first fruits of the expected surrender, the Mexican Bureau of Mines reports that 400 companies have filed applications for resuming work in Villa's old stamping-ground in the central North.

The only remaining war-cloud is one newly arisen in the Territory of Lower California, where the Carranzista Governor, Esteban Cantu, has reigned for many years as an almost independent satrap. At first Cantu tendered his allegiance to the new government; but, when summoned, a little later, to Mexico City for a conference with President De la Huerta, the satrap refused to budge and began to fortify his territory to resist invasion. About this time, various Carranzistas—proscribed by the new government as vulgar criminals, or else irreconcilable—who had escaped to the United States, held a meeting at San Antonio, Texas, under the leadership of the infamous Luis Cabrera. They evidently voted to back up the rebellion of Cantu, because Lucio Blanco soon left for Lower California to lead the rebel army, and a number of these exiles are now aiding Cantu with money and advice.

The new provisional president, Adolfo De la Huerta, should not be confused with the unspeakable Victoriano Huerta, who sprang from quite a different family and State. Besides being twice governor of Sonora—once in 1916, by appointment, and again in 1919, by election—Don Adolfo was sub-secretary of Gobernacion in 1915 and Federal senator in 1918. Partly of Indian blood, he was this year elected chief of the Yaqui nation. In his youth he enjoyed an education unusually good for a Mexican; in consequence he is open-minded toward new ideas and progressive in his political tendencies. Personally, he is affable and democratic, and his popularity is evidenced by the testimony of Villa, who gives his admiration of De la Huerta—with whom he was associated in 1913—as one of the leading motives for his proposed surrender. Of early-middle age and naturally robust, he is at present suffering from appendicitis, which interferes lamentably with his desire to fulfil properly the numerous duties of his high office.

The new government has extended amnesty toward all Carranza's followers, except those guilty of vulgar crimes. Among the latter, Luis Cabrera was cunning enough to evade capture and escape into Texas, whither Juanito Barragan soon followed him after he had eluded his jailers in Mexico City by an unscrupulous trick. Thence fled, too, Colonel Fontes, the despoiler of the National railways, and General Candido Aguilar, son-in-law of Carranza and erstwhile liberator—and looter—of fertile Vera Cruz. Of all the old ring, only two notables were safely jailed, Licenciado Berlanga, minister of Gobernacion, and General Murguia. The former is now on trial on charges of misappropriating public funds and corrupting the daily press; but the latter turned honest some years ago, so that evidence to incriminate him now is probably lacking. Yet while engaged in accumulating his present considerable fortune, Murguia was perhaps as audacious as any of his 'reforming' confrères. Not content with the usual conventional toll of a Carranzista general arising from a shamelessly padded payroll and supply-list, Murguia seized for himself in 1915 the whole of two bonuses—one of ₱300,000 and the other of ₱150,000—sent to him by Carranza to be distributed among his troops as rewards for their successful campaign in the West.

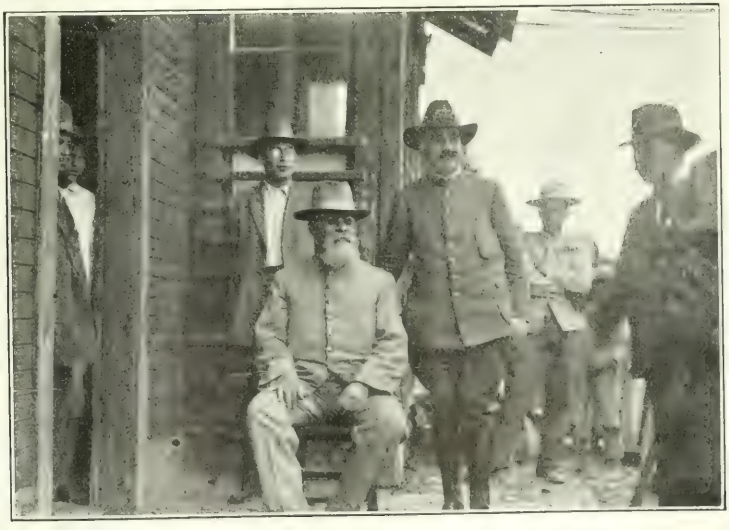
As the first fruits of Don Adolfo's campaign against military graft, his government now finds itself with sufficient funds to pay its civil servants henceforth fully in cash, instead of the payment of 75% cash and 25% bonds practised by Carranza. Not only graft must go, but all superfluous troops, and especially the scandalous redundancy of officers maintained on public pay since 1915. A garrison with one general and eight or ten lower commissioned officers to 100 private soldiers and 'noncoms' was a common thing; while in certain centres, like Mexico City, were assembled the 'unattached' officers, in huge droves, which resembled nothing so much, in their lack of social utility, as the bachelor-seal herds or the similar *guanaco* bands of the Andes. A recent comical incident of army revision was the case of a general who thankfully accepted the rank of lieutenant rather than suffer the calamity of complete erasure from the army payroll. The proposed speedy reduction of the army to 50,000 men is certainly the first move essential to any economic rehabilitation of the country. Last year 120 out of the 200 million pesos of Federal revenue was spent by the War Department.

The Department of Bienes Intervenidos (intervened properties) was originally instituted by Carranza as a scheme to deprive his political enemies of any funds with which to oppose him. It has its excuse in the shameful betrayal of Madero by the Diaz *cientificos* after he had been so foolishly generous as to leave undisturbed their huge fortunes stolen from the nation. The intervened

properties comprised not only hundreds of the ranches, mines, factories, and residences of individuals, but numerous schools and asylums belonging to the Catholic

GENERAL ALVARO OBREGON

church. Many of the large buildings intervened were used as military barracks, and, as most Mexican soldiers have the personal habits of swine, the effect of their resi-



THE LATE PRESIDENT CARRANZA AND SENOR PABLO GONZALES

dence on the furniture, woodwork, and decorations of these edifices can readily be imagined. The intervened ranches were usually stripped of their livestock and other chattels, while the mines were gutted of all developed high-grade ore. Originally proclaimed as a temporary measure, the intervention department proved so profitable to its operators that it was continued in full blast until the fall of Carranza. The new government has now reversed this policy and is returning the intervened properties as fast as their owners can be identified, while the Department itself will be abolished in September.

Outside the National system of railways, of which control was obtained through stock-ownership by the Federation in the time of Diaz, the leading trunk-line of the

country is the 'Mexicano', which was first intervened by Carranza in 1914 and continued (except for an interval in 1916-'17) in his possession until his fall. This line has now been returned to its English owners, who will be indemnified later for their long deprivation of its earnings.

Next to the President, the leading public figure at present is General Salvador Alvarado, the Minister of Finance. A revolutionist ever since 1906, when he helped to lead the great strike in Cananea, Alvarado first rose to fame in 1915 when he invaded Yucatan as a Carranzista general and soon became its military governor. His administration of the State, which lasted till 1918, was one of the most extraordinary phenomena of the Revolution. Yucatan, a country of half-savage Indian peons and vast henequen plantations, was transformed (on paper) by Alvarado into one of the most civilized Utopias ever conceived, in fact or fiction. In 1918, evidently tired of playing the game of a creative statesmanship that failed to function, he left Yucatan. During 1919 he amused himself, and dropped ₱100,000 of his savings in starting a new Mexico City daily, 'El Heraldo Mexicano'. Later he was arrested by Carranza and tried for sedition, but for lack of evidence was acquitted. Shortly after he took refuge in the United States and published his famous exposure of the Carranza administration.

Having always been an ardent supported of his fellow Sonoran, Obregon, on the triumph of the latter he naturally was given a high place in the new government. In his present office, Alvarado has been as active and audacious as ever, chiefly busying himself with uncovering the corruption of his predecessor, Luis Cabrera. The first mare's nest exposed was in the Casa Monetaria (Treasury bank) which had made loans of two million pesos to various Carranzistas without any security. Next came two bureaus of the War Ministry, the first of Military Police and the second of Military Instruction in Public Schools, which employed numerous officials and cost two millions per annum, but never did any work. Later, he abolished the use of the 'infalsifiable' paper money, which, ever since its demonetization in 1916, has been 'redeemed' by requiring a bonus of its bills to be added to every payment of certain Federal taxes assessed in coin. He now proposes to launch the Banco Unico (unique bank) which has been mooted ever since 1916. This bank will monopolize the issue of bank-bills formerly distributed among the State banks—looted in 1916-'17 by Carranza—and if its inauguration is accompanied by doing justice to the latter it will mean much for the restoration of normal commercial facilities, lacking since 1914.

The recent re-opening of the kidnapping case of U. S. Consul Jenkins of Puebla has exposed to the public gaze the clumsy conspiracy hatched by Carranza to incriminate Jenkins in order to relieve his government of any responsibility for re-payment of the $150,000 ransom. Exactly why Carranza should have gone to all this trouble is inexplicable, for he could easily have filed the Jenkins claim, along with the thousands of others, in the archives of his fundless Claims Commission, and let it go at that.

Last month the Republican (Catholic) party held a convention in Mexico City and nominated an engineer, Robles Dominguez, for the Presidency. This is the first time the Catholics have dared to hold a political meeting since 1914, and though Dominguez has perhaps no chance of being elected, the very fact that his candidacy is permitted by the Government shows how things have changed.

A recent Federal decree, designed to encourage the resumption of mining, remits the usual fines for non-payment of back taxes for all delinquents who will pay up for the first and second thirds of this year before August 31. Previous back taxes may be paid pro-rata with future current payments until liquidated, but failure to now take advantage of this final and liberal offer will result in forfeiture of the mining claims or titles involved.

The same syndicalist propaganda that was widely subsidized by Carranza in 1915, as a weapon against his rivals, but suppressed by him in 1916 on discovering its boomerang nature, has now re-appeared in its brand new dress of Bolshevism with Russian trimmings. The leader seems to be a young American journalist, named Gale, who is said to have fled here, in 1918, to escape the draft. After stirring up the usual ruction in the recent strikes at Vera Cruz, at Tampico, Bolshevism is now face to face with the new government, and it is safe to predict that its heyday of trouble-making has come to an abrupt end.

In either vertical or inclined shafts, skips or cages must not be overloaded; and boards must not be placed across the top of skips and men permitted to ride thereon, unless a side-casing is provided as a protection, according to the mine-safety standards in Colorado. Guides or back-runners should be installed in all shafts when the inclination is more than 20° from the horizontal. Safety-catches should be used on man-cages or skips. These safety-catches should be inspected daily and tested once a month. When hoisting or lowering men at the beginning or end of shifts, special cages or skips should be used in all shafts where the angle of inclination from the horizontal exceeds 20°, and when the angle of inclination exceeds 30°, such cages or skips should be equipped with bonnets to protect men from falling rock. Safety-gates should be used on cages for hoisting men. Men should never be hoisted or lowered faster than 800 ft. per minute. Conditions may require slower speed for safety. Where buckets are used in vertical shafts over 100 ft. deep, cross-heads should be used. Where men ride on the buckets a suitable bonnet and safety-catches should be used on cross-heads. Cross-heads should be securely fastened to the cable. The guides of vertical shafts and the tracks and back-runners of inclined shafts should be inspected daily. Where inspection shows that guides or tracks have been shifted by moving ground, repairs must be made immediately. Wall-plates must be kept clear of accumulations of broken rock. Men should not be allowed to crowd around the shaft-collar or the station, previous to lowering or hoisting.

Some Controlling Factors in Flotation

By RALPH D. NEVETT

*The object of this paper is to offer some suggestions to assist metallurgists in supervising the operations of flotation plants. We do not yet thoroughly understand what 'flotation' is, or 'why minerals float'; all attempts that have been made to explain the phenomena have been based on theory or imagination, and have not been capable of substantiation by practical demonstration, or even by laboratory tests; but it is well known that particular minerals will float in a liquid under certain specified conditions, and that some other minerals will not float under those conditions, and that, if a mixture of the two classes of minerals be subjected to those conditions, there will be separation of the minerals, of which one class will float and the other will remain unfloated as a residue. The duty of the expert is to so control the operations and the conditions of the liquor as to obtain the best commercial result from the ore he is treating.

The chief controlling factors in a flotation plant appear to fall under the following eight headings, all of which are important:

1. Crushing.
2. Rate and regularity of feed.
3. Density of pulp.
4. Temperature.
5. Addition agents.
6. Condition of circuit liquor.
7. Agitation.
8. Aeration.

Crushing

The ideal feed for flotation treatment is the true slime, which has been the bugbear of metallurgists throughout the ages. This fact should be remembered and taken advantage of wherever possible, although it would not be profitable, as a rule, to continue the crushing operation on crude ore to so great a degree as to make a slime of it. It may be generally accepted, however, that it is bad practice to have any particles remaining on a 40-mesh screen. This is not true in some exceptional cases, as sometimes, for instance, with laminated minerals such as molybdenite and certain copper ores.

Whether the degree of crushing is qualified by classifiers or screens, it is advisable for the metallurgist to assume personal control by having sizing-tests made on regular samples of the crushed feed. In practice it will be found generally that the undersize of a 20-mesh revolving screen, with 45% screening area when fully loaded, will almost entirely pass through a 40-mesh laboratory screen. An efficient crushing plant is the first essential for flotation treatment.

There are two reasons why the ore requires to be crushed so that all particles will pass through a 40-mesh screen:

1. Because the bubble of air or gas that becomes attached to a particle has not sufficient power to float larger particles of mineral which are produced by any other coarser crushing. If, moreover, a bubble of gas were large enough to float a larger particle, the resistance it would offer to the flow of the pulp would probably cause it to be wiped off and removed from the particle before it had time to reach the surface of the flotation bath.

2. Large particles of ore, when hurled around in the agitation zone of the flotation vessel, do considerable damage in hindering aeration by cutting bubbles of gas off other particles of mineral.

Rate and Regularity of Feed

It is essential that the rate of feed going into the flotation plant should be as nearly regular as possible each second of time. There is nothing that interferes so much with treatment as irregularity in the rate of feed and irregularity in the quantity of liquor passing through the plant from moment to moment. It is a simple matter to make the rate of feed and liquor regular by means of a large agitator or Dorr thickener placed at the head of the treatment vessels. This agitator or Dorr thickener can store quantities of feed supplied to it in an irregular manner by the preparatory plant and deliver it in a regular flow at its discharge to the treatment plant. This storage of slime also enables the flotation plant to be operated continuously through any small stoppages of the preparatory plant.

Density of Pulp

It is necessary that the feed should be introduced to the treatment plant, in the form of pulp, at the pre-determined density best suited to the process. The density should be maintained at a regular rate from moment to moment just as strictly as the rate of feed itself.

Extensive experiments were made on the dump from the flotation plant at the Junction North mine for the purpose of determining a suitable density and rate of feed. It was found that variations of density had an important effect upon the rate of feed that could be treated. When the density was 56% solid, it was impossible to treat more than 8 tons of dump material per hour, and then only with poor metallurgical results. When the density was reduced to 35% solid, the same plant treated 24 tons of material per hour with excellent metallurgical results. This fact alone shows how easily a flotation plant can go wrong.

It will be seen from this that the rate of feed and density are allied with each other and complementary, and should be kept under constant control. The following is a quick and reliable method for controlling the density of the pulp in a flotation plant:

*From the Proceedings of the Australasian Institute of Mining and Metallurgy.

A tin is made to hold 1000 cc. of water up to a mark, say, about half an inch below the top. The tin is dipped quickly into the flowing pulp and filled up to the mark. It is then weighed, using a counterpoise for the tin. The shift-boss or operator should make such a density test at intervals not greater than 15 minutes. The weight of the pulp would be, say, 1350 to 1400 gm., which represents about 30 to 34% of solid in the pulp at the dump-treatment plant at the Junction North mine. If the weight is greater than 1400 gm., the operator adds water to the pulp as it leaves the Dorr thickener.

Temperature

On some ores flotation can be carried out in the cold, but a good many require heat to a limited extent. Sometimes, on ores containing several minerals, it is necessary to have a little heat for the flotation of one mineral and a greatly increased amount of heat for the flotation of the second mineral. At the dump plant at the Junction North mine in the selective flotation of lead and zinc sulphides by either the Bradford process or the Palmer-Seale-Nevett process, it has always been necessary to watch the temperature of the pulp very closely. In the lead section the most suitable temperature was 89° to 90°F. Even a single degree over 90°F. has been detrimental to the grade of the lead concentrate, as zinc sulphide commenced to float with the lead concentrate with the rise in temperature. In the zinc section the best results were obtained at a temperature of 135°F. with the Bradford process, and at a temperature of 125°F. with the P. S. N. process. If the temperature is allowed to drop to 130°F. in the former case, the zinc concentrate is not completely floated, and a loss is made in the residue. No benefit is gained by increasing the temperature above 135°F.

Metallurgists, wherever possible, like to treat the ores with as little added heat as possible, to save cost. Wherever heat is required, attempts are made to utilize the exhaust-steam of engines and similar sources of heat. It is not always possible, however, to make use of exhaust-steam in this way, even if it be available. The favorite method of heating, although perhaps the most expensive, is by the introduction of high-pressure steam direct from the boilers to the pulp, which is always convenient and easy to manipulate, and has quick and effective results, requiring only the operation of a valve from time to time for keeping the temperature of the pulp constant. The ease with which high-pressure steam can be obtained by the operator, and the fact that the extra temperature does no harm in zinc treatment, makes it liable to be wasted considerably. A close watch therefore must be kept on the steam consumption in this way, as it might, besides being wasteful in cost, tend to overload the boiler-plant if it is otherwise working at high pressure.

Addition Agents

In all flotation plants it is necessary to add some chemicals. The point at which such chemicals should be added is an important one, and should be determined carefully. It is a matter of vital importance that the valuable minerals in the pulp should be in a properly prepared condition suitable for floating before the pulp enters the machine. For the purpose of ensuring this, it is obvious that whatever chemicals are required should be added to the pulp at least before it reaches the flotation machine. Frequently the purpose will be served if the chemicals are added in the agitation machine, but sometimes it is advisable to add them to the pulp before that.

When acid is required, generally speaking the best place to add it is in the agitation machine, although it may sometimes be added directly to the flotation machine. Frequently acid produces gases, such as sulphuretted hydrogen, by action upon the pulp. These are harmful to flotation, and it is advisable to let them have time to disappear before the pulp reaches the flotation machine.

Oil is not an essential reagent in flotation, but when it is used it should be added far enough back in the flow to ensure its emulsification in the pulp before it reaches the flotation machine. When it is not thoroughly emulsified, oil is distinctly detrimental to flotation. Oil should never be added directly to the flotation machine, but may be added in the tube-mills or other grinding machines or in the return-liquor pump or in the agitation machine, as may be found best in practice.

Condition of Circuit-Liquor

Usually it is convenient to employ the ordinary mill-feed water for making up flotation circuit-liquor. The first essential is that this water shall be clean, that is, free from sediment. Such feed-water is usually drawn from the underground drainage system, to which has been added some fresh water from the surface supply. The mine-water would probably contain a certain amount of salts in solution, and in some cases the proportion of salts in solution would render the water unsuitable for flotation.

The mill-water coming in contact with the ore usually dissolves a good deal of the soluble impurities, and by the time the water reaches the flotation plant it might be too heavily charged with salts to make it suitable for acting as a flotation circuit-liquor.

The circuit-liquor requires some properties other than cleanliness to ensure its successful use in a flotation plant, but it is not clear what those properties are. For a long time it was thought that it was necessary to have at least a comparatively large definite quantity of salts in solution, and that this was the main controlling factor in the constitution of a good liquor for flotation. From many tests carried out at the Junction North mine, it would appear even yet as if the quantity of salts, and kind of salts, in solution exerted an important influence on the operation. It was noticed sometimes, when the flotation plants were not working well, that the quantity of salts in solution had either dropped below 1400 gr. per gallon or had risen above 2600 gr. per gallon. It would seem from the various tests that the best results were obtained when there were about 2000 gr. of salts per gallon in the solution. The salts were mainly salts of manganese, zinc, iron, and calcium. It would be a difficult matter to carry

out a set of tests either in the laboratory or in an operating plant to prove the effect of salts in solution. The ore itself, containing soluble salts, would, as soon as it came in contact with pure water, immediately provide some salts in solution.

A good deal of work has been done at the Junction North and by other investigators to endeavor to determine the actual effect of certain specified salts in solution, and much interesting information has been collected; but it has never yet been shown that any of the common salts that naturally go into solution in the Broken Hill treatment have a marked influence upon results, unless present in excessive quantities, and none of the salts known to exist in the circuit-liquors at Broken Hill have anything like so great an influence upon the treatment as to explain the reason why some flotation-liquors are energetic and others dull in their action. It is distinctly noticeable, when flotation work is going on successfully in the plant, that the liquor has some property which has never yet been thoroughly defined, and it seems to be a physical property denoting energy which has been instilled by some means into the circuit-liquor. Sometimes the nature of the liquor can be corrected by alteration in the oiling; sometimes by alteration in the application of acid. The new P. S. N. process claims to correct the conditions of the liquors in many cases by the addition of elemental sulphur.

If oil exists in the circuit-liquor, it must be emulsified. Free oil is detrimental to flotation work, as can easily be seen in the Cascade process. If a few drops of oil are admitted to the first Cascade vessel, its effect will be seen on each of the following Cascade vessels of the series in killing the float that was just previously there.

Agitation

Agitation is beneficial in all methods of flotation on all classes of ore. Some, however, do not require so much agitation as others, and calcitic ores treated by purely acid processes usually require only a moderate degree of agitation before treatment. The quantity of calcite present in the ore need not be more than a few pounds per ton. The acid readily sets free the carbon di-oxide gas which, being nascent, rapidly attaches itself to the mineral particles and floats them. The intimate association of the calcite in the ore ensures successful gassing. Such ores as do not contain calcite or any other carbonates require treatment by agitation-aeration, by which the atmospheric air is beaten into the pulp, to cause the attachment of bubbles of air to mineral particles. The M. S. machine was originally designed for this purpose, and later on the Owen patent and Lyster patent showed other means by which it could be carried out more effectively and more completely. The agitation should be carried out in the treatment-vessel so that the mineral can rise to the surface of the vessel and be removed without having to travel a greater distance than is absolutely necessary, or, in other words, to avoid overtaxing the ability of the bubble to retain its hold on the mineral particle for leading it out of the flotation-bath. However, I am strongly in favor of providing some kind of machine at the head of the treatment; for instance, a vortex mixer or an M. S. mixer, or a larger agitation machine, to provide that the pulp shall be thoroughly agitated and partly aerated before it enters the treatment-vessel. This pre-agitation aeration incorporates oils, reagents, acids, etc., and probably causes some beneficial effect by oxidation of some of the substances, and so saves the first treatment-vessel from being wasted on this work. It might be, too, that some deleterious substances are formed immediately upon application of the acid and reagents, such as noxious gases like sulphuretted hydrogen, which, in this preliminary incomplete agitation-aeration, are either driven off or altered to make them innoxious, and, in this preliminary agitation, chemicals or acid or perhaps oil may be added, the temperature being controlled so that when the pulp enters the machine it is ready for separation of the valuable minerals. It is even advisable to add the chemicals or oil or acid to the pulp before it enters the preliminary agitation machine.

With some simple ores very little agitation is required before the pulp passes to the flotation machine, and, in such cases, if the pulp is lifted by bucket-elevators direct to the flotation machine, sufficient agitation will be provided by the elevators for successful separation. In that case the chemicals and other reagents may be added, perhaps, at the boot of the elevator. The bucket-elevator may be looked upon as a first-class agitator, although the period of agitation provided by it is very short.

If the pulp requires much acid or heat added to it, it is advisable to have the agitation-vessel at the head of the flotation machine besides the elevator, because in such cases the elevator-belt would suffer severely if it handled hot or acid liquors.

Agitation is always beneficial to flotation, and in most cases it is absolutely necessary. It has a cleaning effect on the particles, and, if oil is used, causes a greater emulsification and distribution of the oil. To ensure a more complete flotation of the particles, it breaks up the bubbles of air and distributes them in a free state of division throughout the pulp in such a manner as to give every particle of mineral a chance to become attached to air-bubbles.

Aeration

Aeration means the introduction of air into the pulp in a finely-divided condition so as to form a froth, in order that the particles of mineral may become attached to finely-divided air-bubbles, by means of which they are buoyed upward to the surface of the flotation-bath and removed across the periphery as a separate concentrate. Air for aeration was originally introduced into the M. S. machine by being sucked down to the impeller from the surface through the vortex and disturbance caused by the agitation. The quantity of air so converted into froth was always indefinite and not under control, and for this reason flotation results were very changeable. It was necessary to have the agitation-aeration zone in another vessel separated from the flotation-bath, because the latter required a quiescent surface, which could not be provided by the former. This was a severe handicap,

as it required the bubble to travel a great distance before it could be rescued at the surface; consequently, only the most powerful methods of flotation could be used with it, such as would develop combined flotation and not permit of any selective action.

It was found by Owen that if agitation and aeration were carried out in the flotation bath itself the bubble would have a much shorter travel, and much more delicate flotation work could be carried out. The effect of this was to permit of selective flotation on one mineral in preference to another. By means of the Owen process, air was either sucked in by impellers or pumps, or was introduced as compressed air and delivered to the impeller in such a manner that it could be most effectively beaten up into a foam.

Later on, at the Junction North, it was found that definite control could be obtained to govern the quantity of aeration introduced into any pulp, and measurements could be obtained of the amount of aeration by means of a steelyard or an ordinary water-gauge tube, graduated and placed outside the flotation vessel and connected with it. It was found afterward, by means of the Cascade process, that aeration could be adequately obtained by means of entanglement of air with the pulp as it fell down open pipes.

It is essential that the air should be completely atomized in the pulp and not allowed to be distributed through the pulp in the form of comparatively large bubbles. This must be carefully watched when aeration by compressed air is adopted. If the supply of compressed air is too great through any one delivery pipe, then the air is distributed throughout the pulp in the form of large bubbles, which are unsuitable for flotation. These large bubbles rise rapidly to the surface and disturb the quiescent zone, so that some of the float already there is caused to sink again and some of the gangue is caused to overflow the periphery and spoil the concentrate. Compressed air must be added in such a way that it enters the pulp in the zone of maximum agitation of the impellers. The force of agitation at that point will determine the amount of air which may be effectively taken from the supply-pipe. If it is desired to atomize a still greater quantity of air than can be dealt with from one supply-pipe, it is possible to gain such an increase in any particular flotation machine by increasing the number of air-supply pipes around the impellers or by increasing the speed of the impellers.

In the Cascade process the air is drawn in and entangled by the pulp as it drops down the vertical pipe and becomes atomized by the splashing of the pulp in the impact, which occurs when the pulp hits the surfaces of the liquor and metallic parts of the flotation machine. It is generally advisable in the Cascade process to have a cup placed below the bottom of the vertical pipe to intensify the impact.

A [illegible] for the record for rapid sinking of timbered shafts comes from South Africa. Of two new shafts at the New State Areas property, one was sunk 920 ft. and the other 1338 ft. during the past year. Both shafts developed large quantities of water and progress was made under difficulties. At the south shaft a dolerite dike was intersected above the dolomite horizon. It weathered rapidly on exposure to the atmosphere; so to ensure safety the shaft was closely timbered, and the space between the dike and timber filled in with concrete, thoroughly reinforced. Since passing through the dolomite series both shafts have made rapid progress. The average rate of sinking for the first four months of 1920 was: north shaft, 225 ft. per month; south shaft, 247 ft. per month. The world's record for a timbered shaft till this year was 224 ft. in one month, but the south shaft had averaged a greater footage for four months, while an advance of 270 ft. in March exceeded the previous record.

Dust in Metal Mines

Dust in the air in metal mines probably causes more sickness and ultimately more deaths among miners than any other cause. In the opinion of experts of the Bureau of Mines any kind of dust will ultimately be harmful if breathed in large quantities, and this includes not only silicious dust, but coal dust, which some authorities believe has no harmful effect, lead-carbonate dust, and arsenical dust. The most harmful is probably free silica (quartz, flint, etc.) especially in the finer sizes. The hard, sharp, insoluble particles cut and injure the lung tissue, making it more or less inelastic and incapable of expansion, and ultimately bring on miner's consumption. It is probable that more than half of the common metal ores have a silicious gangue, or occur within silicous wall-rock. The finest dust, which is the most harmful, is invisible, and the dust is tasteless and odorless. It is chiefly raised in the air by dry drilling, blowing holes dry, blasting, shoveling, and tramming. The fine dust, once raised into the air, remains suspended many hours in still air, hence in poorly ventilated places the miners breathe this fine dust continually. By far the most dangerous condition is that of breathing dusty air in a hot humid stagnant place all day, and then going home in perspiration-saturated clothing through air frequently many degrees below zero.

Miner's consumption and lead-poisoning among metal miners are both caused by dust and are wholly preventable. The most effective prevention of dust in mine air, apart from elimination of dry drilling, is the circulating of pure air at the working face. Also, piles of broken ore should be wet down, and the timbers, floor, and walls of dusty working places should be sprinkled. The effectiveness of good ventilation in preventing miner's consumption is illustrated by two mining districts in the United States. In both districts the mines have cool rock and air and dry silicious ore easily broken into fine dust. In one district the method of mining requires constant shooting, so the mines all have moving currents of air at nearly all the working places; in the other, little or no air is circulating at working places. In the former, miner's consumption is practically unknown, in the latter it is a common disease.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

G. H. DOWELL OF THE COPPER QUEEN COMPANY TALKS OF THE FUTURE OF BISBEE.

BISBEE.—A full face of sulphide ore, a general sample of which assayed 19% copper, has recently been exposed in the Boras mine. The importance of this find lies in the fact that this is the first sulphide ore found in this section of the district. It is possible that this discovery may tend to alter geological opinion as to the nature and depth of copper deposits and have considerable bearing on mineral operations in this section. The ore was found in a drift on the 600-ft. level of the Chance claim, west of the shaft, and every indication pointed to a big body of good sulphide ore. Considerable doubt has been expressed in regard to the possibility of finding sulphide ore in the vicinity of the White Tail Deer mine of the Copper Queen, where the Boras is situated. Development of the newly discovered orebody will be watched with keen interest. Prior to this find the Boras company had nothing but oxide and carbonate ores to ship.

The concreting of the Dallas shaft of the Copper Queen is progressing rapidly, about 21% of the work being already completed. Sinking to the 2000-ft. level is being pushed, and a tunnel is being driven for use as a conveyor-belt tunnel. The power-plant and hoisting-plant at the Sacramento shaft will shortly be moved to the Dallas and both will probably be housed under one roof. When completed the Dallas shaft will become the main hoisting-shaft for the Copper Queen, taking the place of the Sacramento, which will in time be caved as operations on Sacramento hill progress.

At a recent meeting of the Bisbee Luncheon Club, G. H. Dowell, manager of the Copper Queen branch of the Phelps Dodge Corporation, said in part: "The company that I represent depends largely on the income from this property for the development of other properties. As you all know, operations have been restricted during the last year or so on account of the inability of the company to market copper, but all look forward to a time when we will be able to market all the copper we can produce. In addition to normal mining operations, there has been the work on Sacramento hill. The company has invested there already about $5,000,000 and before the project is ready for operation will have invested more than $8,000,000. I remember that a speaker here some time ago remarked that Sacramento hill is an illustration of the saying that faith will move mountains, but I have found that it takes something more than faith to move Sacramento hill. The project is really just begun. We have moved up to date about ten million tons but before the project is completed we will have to move more than 80,000,000 tons. The companies and the community here as elsewhere have the problem of labor supply. We have

VENTILATING-STATION AT THE INSPIRATION MINE. FANS HAVE A CAPACITY OF 226,000 CU. FT. PER MINUTE

had and have now all the labor we need under present production conditions. I think we will have enough when the time comes to arrive at a normal output, about eight million pounds of copper per month. It has been the policy of the company to employ English-speaking men underground. About 80% of those working underground are Americans. I hope the company will be able to continue this policy. On Sacramento hill the company has been forced to employ much Mexican labor, but you should understand that this is only a temporary condition. When the Sacramento Hill project is completed most of these will be laid off."

Residents of Douglas who were injured by flying bullets from across the line during the fighting at Agua Prieta in April 1911, last week received from the war department warrants in settlement of their claims. Five claims, amounting to a total of $17,000, were paid. One claimant was injured by the shattering of window-glass in the residence of the superintendent of the Copper Queen smelter. These claims have been pending against the Government for nearly ten years. A commission, appointed by the secretary of war, investigated the claims in 1912 but it was not until 1918 that Congress included in the general war appropriation bill an appropriation of $71,000 to pay in full the awards of this commission on the claims arising at Douglas and Bisbee.

JEROME.—Orders have been received to resume diamond-drilling operations at the Pittsburg-Jerome. The first drilling done will be to complete an underground hole which had been started when the shut-down came last spring. After it is finished, a 2400-ft. hole will be started from the surface. It is understood that the strike at the Shea is responsible for the decision of the Pittsburg-Jerome directors to resume prospecting.

A moving picture company is spending several weeks in Jerome in order to snap scenes for a new picture 'West is West'. The special feature to be filmed is a strike in what is known as the Torpedo mine in the story. Some of the pictures are being made in the streets of Jerome, others in the United Verde and United Verde Extension Mines, and the J. S. Douglas residence. Several of the scenes will be taken on the 1700-ft. level of the United Verde mine.

Just recently the short-line road from Prescott to Jerome, the centre of the rich Verde mining district, has been opened up for travel. Credit for this wonderful piece of highway work is due not only to the State and Federal authorities, but to the Yavapai County chamber of commerce which started to obtain this improvement and never stopped until the road was built. The old route over the Cherry Creek hill was 62 miles long, while the new road is 32. When the road is capped and graveled, the running time will be about 1½ hours.

The Jerome-Superior has reached a depth of about 900 ft. and will sink 100 ft. more before starting lateral development. The surface equipment is ample for about 2000 ft. of sinking. It is reported that a new corporation, the Crater Mining Company, said to be an annex of the United States Smelting & Refining Co., has been formed to drill the famous meteor crater west of Winslow. Two standard drilling-rigs have been purchased and will be erected near the inner edge of the 4100-ft. pit, with the expectation that the meteor plunged into the earth at an angle from the vertical. Exploration was conducted for a period of years by a Philadelphia company, that found great difficulty in handling the quicksand that filled in the great hole. Fragments of the meteor, however, were found, although it is believed that the main mass has not yet been found. The metal, as shown by analyses of the fragments within and around the pit, contained a remarkable proportion of nickel.

COLORADO

NEW DISCOVERY ON 1800-FT. LEVEL OF THE VINDICATOR AT CRIPPLE CREEK.

CRIPPLE CREEK.—A rich shoot on what is believed to be the extension of the Lillie vein, has been entered at the 1800-ft. level from the Vindicator Consolidated company's No. 1 shaft on Bull hill. The discovery was made in virgin or undeveloped territory about 900 ft. south of the shaft station. The vein is a strong one measuring 8 to 12 ft. between walls and contains seams of sylvanite in quartz. The ore is reported to assay as high as 30 oz. gold per ton, while the general average of the sorted product assays from $75 to $150 per ton.

KOKOMO.—Organization has been effected of the Kokomo Mining Co. to operate the Pearl Consolidated group, formerly controlled by the late Charles J. Moore. Modern equipment is to be installed and development in charge of Stillwell Conner, who formerly operated in the Cripple Creek district, is planned. A mill will be constructed and plans are being prepared. A large tonnage of ore averaging 16 oz. silver per ton is on the dump and ore of higher grade is being developed by a tunnel and shaft.

MAYDAY.—A 35-ton mill, with modern equipment, is the consideration paid by W. B. Cauble, of Peoria, Illinois, for an undivided one-half interest in the Esmeralda group, in the La Plata district, to the owners, M. De Luche and George Smart of Durango. The material will be shipped from Denver and the mill construction will start as soon as plans are approved.

BOULDER.—Four distinct veins, all rich in silver, have been opened and are under development on the property owned by the Caribou Hill Mining Co., recently organized by W. W. Robinson, of Colorado Springs, and Denver associates. The company secured by purchase 14 claims, some adjoining the famous Caribou mine. Two shafts, one 200 ft. and the second 140 ft., are on the property but had not been worked for 20 years. They were in poor condition and half full of water when possession was taken. Samples of the ore taken from the workings of the No 2, or 140 ft., shaft were assayed with the following results: 1402 oz., 390 oz., 155 oz., and 584 oz. silver per ton. The claims are all patented and are among the oldest locations on the hill, but the owners had, through lack of funds, been unable to develop their properties.

BRECKENRIDGE.—The Blue Flag company has received

part of the equipment for its Laurium mill, and preparation has been made for installation of the ball-mill and flotation equipment on receipt from the Denver Engineering Works so that the plant can be in operation before winter sets in. The county boundary dispute, involving title to valuable molybdenum mines, which was originally decided in favor of Lake county, has been carried to the Supreme Court of Colorado by Summit county. Attorneys for Summit have petitioned that the writ of error be made a writ of supercedeas.

LEADVILLE.—The Fanny Rawlins Gold Mining Co. is producing an average of 10 tons daily with a force of 12 men. The ore shipped to the A. V. smelter averages about $45 per ton in gold, silver, and copper. A second shift is to be employed. Sundry Leadville lease-operators have taken over the Gold Basin properties and are installing an electric hoist. Sampling of the vein has shown gold content as high as $90 to $100 per ton, as broken, with much higher value for sorted ore. The Gertrude mine in the Sugar Loaf district continues shipments of silver ore to the A. V. smelter. The mine is operated by lessees.

RICO.—July shipments from the Rico Wellington totaled 13 cars, of which 10 cars of lead-carbonate ore was shipped to the Midvale smelter in Utah, and two cars of lead-zinc ore to Coffeyville plant in Kansas. One car of pyrite was consigned to Vanadium, Colorado. Work has been resumed by local mining men who have a lease and bond on the Union Carbonate property, that has been inactive for many years, but when last operated produced a good grade of ore. The Rico Argentine has secured contracts for the sale of its lead-zinc ore and is shipping steadily.

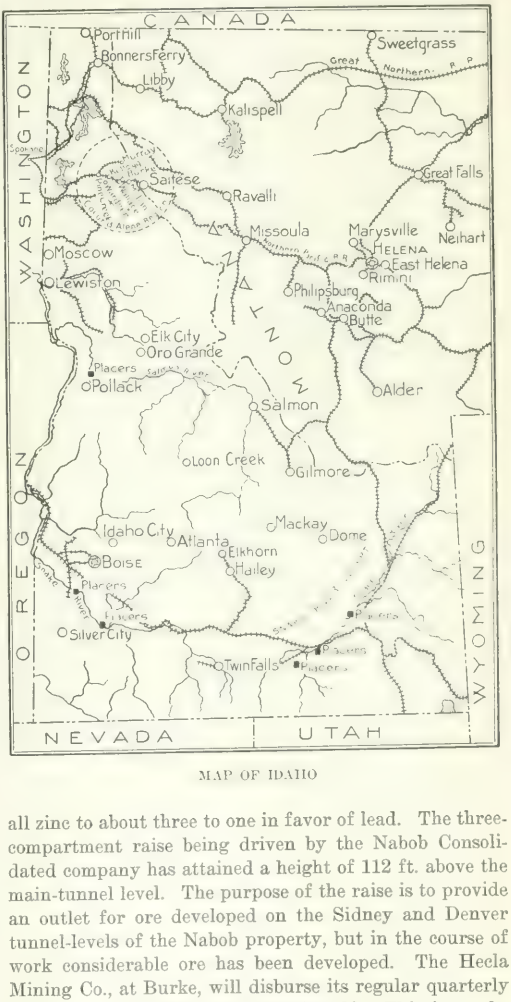
IDAHO

ENCOURAGING DEVELOPMENTS IN UTAH-BELLEVUE MINE, WOOD RIVER DISTRICT.

BELLEVUE.—Assays of ore taken from a drift on a vein traversing the property of the Utah-Bellevue Mines Co. indicate rich ore, according to Joseph H. Saxman, manager, some being as high as 27% lead, 198 oz. silver, $8.80 in gold, and 16.5% zinc. The lowest sample result was of $1.20 in gold and 51.4 oz. silver per ton. The Wood River district, in which the Utah-Bellevue property is situated, is one of the oldest in the State. The principal development at the property consists of an incline shaft, sunk to a depth of 108 ft. Although a vein from 2 to 8 ft. wide was opened and some shipments made, the company decided to develop the ore at greater depth by driving a cross-cut tunnel. Within a distance of 500 ft. several high-grade ore-shoots have been cut, according to Mr. Saxman. Recently a connection between the drift and incline was for better ventilation.

CLAYTON.—Robert N. Bell has secured a long-term lease on some mining property at Clayton. Within a short time, it is stated, he and his associates will erect a 50-ton mill for the purpose of treating the low-grade ores in the 'Red Bird' property. Speaking of the mining situation generally in the State, Mr. Bell says the scarcity of labor and the tightness in the money market have proved serious drawbacks to progress, but that the labor situation was easing considerably, so that he anticipates no trouble in finding miners for his work.

COEUR D'ALENE.—The Tamarack & Custer Consolidated Mining Co., on Nine Mile, is operating with 250 men. It is reported to be producing 3000 tons of lead-silver ore monthly. The Hercules Mining Co. is operating with 600 men, 300 on each shift, and shipping 6000 tons of ore per month. The Friend Mining Co., on Beaver creek, declares that lead ore is taking the place of zinc in the drift from the 50-ft. shaft. The drift is in 20 ft. in an 8-ft. vein. The ore has changed from nearly



MAP OF IDAHO

all zinc to about three to one in favor of lead. The three-compartment raise being driven by the Nabob Consolidated company has attained a height of 112 ft. above the main-tunnel level. The purpose of the raise is to provide an outlet for ore developed on the Sidney and Denver tunnel-levels of the Nabob property, but in the course of work considerable ore has been developed. The Hecla Mining Co., at Burke, will disburse its regular quarterly dividend of $150,000 on September 28. This is at the rate of 15c. per share on the issue of 1,000,000 shares. The company is hoisting from 600 to 700 tons daily and shipping from 2500 to 2800 tons monthly.

MICHIGAN

HANCOCK CONSOLIDATED IS HOLDING WATER IN ANTICIPATION OF RESUMING WORK.

CALUMET.—The recent advances in freight-rates add to the worries of the Lake Superior mine-owners, who are struggling with the burden of a demoralized market, high cost of coal, labor-shortage, and increased cost of materials entering into mining. The rate advance is a major problem. In the case of Calumet & Hecla it will add approximately $40,000 to its coal bill, besides increasing by 35% the cost of hauling 'rock' from the subsidiary mines. Calumet & Hecla has just shipped 1300 tons of billets and ingot bars to Montreal, en route to France. Included in the shipment were a few carloads of copper that had been stored on the old Lake Superior Smelting company's docks at Dollar Bay for more than two years. This was the first copper taken from the 13,000,000-lb. stock since 1918. Steel is on the ground for the addition to Calumet & Hecla's flotation plant, and it is expected that by early winter the two units which the extension will house will be in operation. Accordingly there will be no large increase in the flotation-plant production until next year. The present output of the reclamation plant is at the rate of 16,000,000 lb. per year. Calumet & Hecla has transferred its crew of miners and trammers from No. 16 to No. 15 shaft of the Osceola lode, the former having suspended work. For upward of two months No. 16 has been operating only one shift, with a force of 40 men, as compared with a normal of 60. A few Centennial men have been taken on in No. 15, so the suspension of No. 16 will make little difference in tonnage.

The Copper Range group—Champion, Baltic, and Trimountain—holds production nearer normal than almost any other company on the Lake. While the Copper Range organization suffered early in the year, the output of refined copper indicates that progress is being made in face of adverse circumstances. The production in July was approximately 233,000 lb., for Trimountain, 500,000 for Baltic, and 1,200,000 for Champion. This is even better than early in the year for Baltic and Champion, but slightly below the production six months ago for Trimountain. The yield for Champion in July was 45 lb. per ton, 36 for Baltic, and 30 for Trimountain. This is an increase of from three to five pounds for Champion and two pounds for Baltic, compared with the past six months, while it is normal for Trimountain. Champion is not operating with as many openings as a year or two ago, although developments at the Baltic property are well ahead of the corresponding period of 1919. New openings are being pushed with greater speed at Trimountain. Baltic's principal openings are in the south end, in No. 2 shaft, and all through the West lode. Copper Range still has about four months' supply of copper on hand, or nearly as much metal as at the beginning of the year. There is little possibility of a shortage of fuel at the Copper Range mines, for assurance has been given that cargoes will arrive at regular intervals, with sufficient fuel to carry the mines, railroad, and smelter until spring, when a general improvement in conditions is expected by the operators.

Hancock Consolidated is keeping its shaft pumped out in anticipation of an order to resume operations, but it is likely that no attempt will be made to begin actual mining until there is a considerable improvement in market conditions. With fuel-costs at high levels and the mine only on a development basis, Hancock is saving money by remaining idle. Hancock is well financed for operation, for the bond issue authorized by the shareholders at the annual meeting in July took care of indebtedness and provided a comfortable surplus for the future. The mine is well equipped and the yield has been around 17 lb. per ton. While this is sufficient to pay expenses normally, only production on a large scale gives promise of making a dividend payer.

Seneca's shaft has approached a depth where the driving of a cross-cut will begin. About 60 ft. must be driven. The north drifts on the third and fourth levels have reached a length of slightly more than 600 ft., while the fourth level, south, is near the Ahmeek boundary. The ground to the north has improved materially. In fact all three faces are in good ground. For the time, drifting only will be done as each level is reached and by the time the mine is opened to the 8th, the openings, it is expected, will be sufficiently large to make possible a daily production of 5000 tons of ore. This will be possible by operating on four or five levels simultaneously and this will entail the use of an unusually large hoist and skip. The 13th level drift, south, at Gratiot, something over 650 ft. long, shows consistent improvement and in this respect is fulfilling expectations.

NEVADA

REDMOND CONSOLIDATED COMPANY OWNS PROMISING GROUP OF CLAIMS NEAR LUNING.

LUNING.—Four miles north-west of here are 15 claims owned by the Redmond Consolidated. They are 3500 ft. above Soda Spring valley, but are easily reached over a good road. Five of the claims were bought in 1915 by A. A. Redmond, interested in the Five to One company at Goldfield, and the others were located by him. Before Redmond took over the claims $750,000 worth of ore had been shipped from them and there is now blocked out or partly so, above the 300-ft., or bottom level, 65,000 tons of ore of an average value of $20, according to a report made by Leon M. Hall and Edward A. Southworth. The formation is principally lime-shale, with numerous intrusions of dark-gray porphyry. There are five parallel fissure-veins that can be traced north-east for two miles, or from the crest of the range down the slope toward the valley. These veins dip north-west and, although they are prominent, the width can only be determined definitely in the mine, where on the 100-ft. level vein No. 3 is 70 ft. wide. The outcrop of the veins indicates a width of 50 to 200 ft., with 150 as the average. Some of the ore contains copper and there is a gray-copper vein-capping at several places. The orebody from which the $750,000 production was made was 500 ft. long and 3½ to 12 ft.

wide. It was stoped to the surface from a depth of 135 ft. Much of the ore in the dumps assays $20 in the proportion of three parts silver to one of gold. The work was confined almost entirely to vein No. 3, on which there is a 300-ft. vertical shaft, with 6000 ft. of laterals, raises, and winzes from it. Most of the work was done between the 100-ft. level and the surface and three shoots were mined, one on each wall and one in the centre of the vein. Practically all of the ore came from the centre shoot, although a stope 40 ft. long and 6 ft. wide extends to the surface on the foot-wall. The average value of all of the ore mined was $35 per ton, according to the report. It was treated in a mill eight miles from the mine. The report says the three ore-shoots merge on the 300-ft. level and that a drift has been driven 42 ft. in ore at this depth. A 20-ft. cross-cut from the hanging wall also is entirely in ore. It is estimated that for $50,000 a tunnel can be driven from the valley to cut the veins at depths of 1000 to 2500 ft., including the cost of machinery. A spur track from the Southern Pacific main line can be built on an easy grade to the tunnel, the report says.

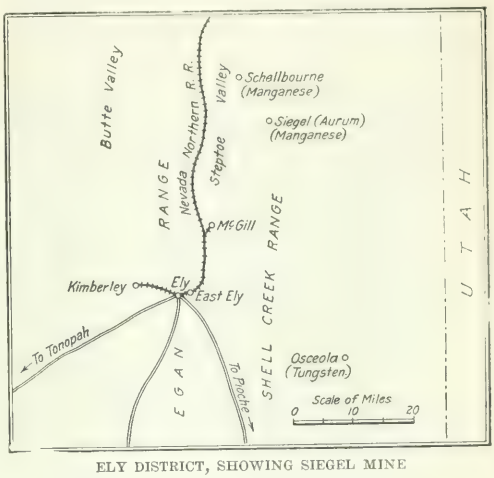
Divide.—The Gold Zone has opened 15 ft. of $16 ore in a cross-cut on the 700-ft., or bottom, level. The vein in which the ore is found is said to be 175 ft. from the extension into the Zone of the Tonopah Divide vein, which is the objective of the cross-cut. This discovery, with recent finds in the Tonopah Divide and the announcement that the Hercules and Giant, Wingfield companies, are to resume work, has caused optimism among those interested in the district. Good reports, verified by disinterested engineers who have been in the mine recently, continue to come from the Tonopah Divide. It is said that much good ore is being found on the fifth level in a vein parallel to the main vein.

Carson.—Representative mining men of the State attended the intra-state rate hearing of the Public Service Commission and petitions were received by the commission protesting against increases in railroad freight-rates. It is reported that the commission will deny the application of the railroads for permission to raise rates, as it is the opinion commonly held that an increase would mean disaster for the mining interests of the State.

Ely.—The Siegel, on the west side of Spring valley, is to be closed if railroad freight-rates are increased. The Siegel is a shipper of silver ore containing manganese and there is blocked out 100,000 tons of ore with an average silver content of 25 oz. The manganese content is as high as 25%. Some of the shipments have contained 200-oz. silver ore. During the quarter ended July 30, the Nevada Consolidated treated 691,095 dry tons of ore assaying 1.47% copper, as compared with 685,944 tons assaying 1.34% in the preceding quarter. The income, after deducting depreciation charges, was $384,000, or 19c. per share. The cost of production, including fixed charges and administration expense, was 15.56c. per pound, as against 20.72c. in the preceding quarter.

Tonopah.—The Rescue is driving a cross-cut on the 1100-ft. level in a vein cut recently near the Belmont boundary line. The cross-cut is being driven from the foot-wall and the opposite wall has not been entered, but indications are that the find is of much importance.

Goldfield.—The drift being driven by the Kewanas on the 825-ft. level of the Merger shaft toward the St. Ives vein in leased ground has been advanced 85 ft. The St. Ives vein is parallel to the Consolidated and the part the Kewanas will prospect has produced well from a depth of 300 ft. to the surface. The vein should be cut in 450 ft. The Kewanas has a four-year lease from August 1 and will pay a royalty of 15% to the Deep Mines after



ELY DISTRICT, SHOWING SIEGEL MINE

freight and treatment charges have been deducted. Nicholas P. Theo, secretary and treasurer for the California Excelsior Oil Co., now drilling in Fish Lake valley, his brother, A. P. Theo, and others have been indicted on a charge of using the mails to defraud in connection with the affairs of the Cuprite Sulphur, a company that formerly operated at Cuprite, south of Goldfield. The indictment was returned in the Federal Court of New York. Nicholas P. Theo was arrested in Goldfield and was taken to Carson by a United States deputy marshal. He was arraigned in the Federal Court at Carson and released on $3000 bail. Fish Lake valley, in western Esmeralda county, is the scene of the latest exploit of the Theo brothers, this time in what is said by some to be an 'oil-field'.

Mina.—Demonstrating the continuity of the hanging-wall orebody from the sixth to the seventh level in the Simon Silver-Lead mine, and indicating that the present ore-reserves will be almost doubled, the recent strike of high-grade milling ore in the raise from the lowest level is important. Ore has been followed in the raise for approximately 100 ft. and any round of shots should break through to the sixth level. Three mill-sites have been surveyed to determine the one best suited for the proposed new flotation plant, the first unit of which will treat 100 tons per day. The engineers are also engaged in examining the foot-wall territory adjacent to the mine with a view to selecting the spot for the new shaft.

UTAH

SMELTING COMPANIES INCREASE THEIR CHARGES AS A RESULT OF NEW FREIGHT-RATES.

SALT LAKE CITY.—Notices have been sent to ore-shippers by the various smelting companies, advising that treatment-charges will be raised to meet the increased freight-rates on bullion shipments. Effective August 26, there was an increase of 33⅓% in the freight-rates on lead bullion and blister-copper from Salt Lake valley smelters to the Atlantic seaboard. In accordance with a provision in the contracts, the smelting companies have the privilege of making deductions from metal quotations to cover this increased cost. These additional deductions amount to 0.25c. per pound for lead, 0.25c. per pound on copper, and 1c. per ounce for silver. It is further announced by the smelting companies that in case the freight advance announced should be modified by the railroads, their deductions will be changed accordingly.

Fifty ore-handlers, employed at the Murray plant of the A. S. & R. Co., went on strike August 21. The men demanded a general wage increase of 50c. per day. J. M. Bidwell, manager of the Utah department of the company, states that operations were not seriously interfered with and that by August 25, practically all of the strikers had returned to work.

In a decision handed down on August 24, the Public Utilities Commission of Utah refused to permit the railways of the State to increase freight charges on shipments of coal and ore.

BINGHAM.—During the first seven months of the present year, the Bingham Mines Co.'s earnings, including those from its 95% equity in the Eagle & Blue Bell mine at Eureka, were $330,803, or $2.20 per share, before allowing for taxes and depreciation. After deducting all charges, the net earnings were $222,783, or $1.48 per share, equivalent to an annual rate of $2.55 per share. During the corresponding period of 1919, the company showed a deficit of about $4000 per month.

ALTA.—Shipments of ore from the Columbus-Rexall mine are bringing good returns, according to R. M. Evans, manager. A recent consignment of four cars assayed 33.7 oz. silver, 13.2% lead, 3.85% copper, and 9.2% zinc, with a gross value of $55.43 per ton. Production at the mine, while steady, is somewhat curtailed due to the prevailing shortage of labor, which is handicapping operations at nearly all of the mines in this district.

PARK CITY.—Probably the best ore yet developed in the Keystone mine has been opened recently. The ore carries approximately 40% lead and 15 to 20 oz. silver, making it worth $60 to $70 per ton. The new shoot is being developed in the No. 3 level from the Kearns and Keith shaft, at a depth of about 1000 ft. The Keystone company operates through part of the K. & K. shaft. For the last 125 ft. No. 3 drift has been following a fissure which has carried some ore most of the way. The main-tunnel level has been extended along the strike of the ore for 25 ft. without getting out of ore. The ore was found making in a lime bedding and a drift was run at right angles to the main-level drift into the bedding. This drift has entered the bedding for a distance of 40 ft. and has been in ore throughout its entire length.

Work was suspended temporarily at the Ontario property recently to permit the installation of a larger pump on the 2000-ft. level, owing to the heavy flow of water. Frank Fleishman, superintendent, reports conditions as favorable on that level and improving all the time. During the week ended August 21, eight mines in this district shipped 2279 tons, as compared with 1776 tons shipped by six properties during the previous week. The Ontario shipped 623 tons; Judge M. & S., 483; Silver King Coalition, 478; Daly-West, 178; Daly Mining, 158; Naildriver, 120; Park-Utah, 51; and Keystone, 110. The Judge smelter shipped 78 tons of premium spelter.

EUREKA.—Mining companies in this district shipped a total of 129 cars of ore during the week ended August 21, as against 122 for the previous week. The Chief Consolidated shipped 34 cars; Tintic Standard, 28; Dragon, 12; Iron Blossom, 10; Mammoth, 9; Eagle & Blue Bell, 8; Iron King, 5; Grand Central, 4; Swansea, 4; Victoria, 4; Centennial-Eureka, 3; Gemini, 3; Tintic Drain Tunnel, 2; Bullion-Beck, 2; and Empire, 1.

A large map of the Tintic mining district, which has been under compilation for a number of months in the office of A. C. Burritt, mining engineer of Salt Lake City, has been completed. The map is seven feet long and covers the entire district from the Knight drainage-tunnel on the south to the Greeley and Utah-Standard groups on the north; and from the eastern limits of the Tintic Standard to the North Beck and North Gemini on the west. Small prints will be available as soon as the plates can be secured.

Jackson McChrystal, manager of the Gemini and Ridge & Valley mines, reports new work at both these properties. From the 1600-ft. level of the Ridge & Valley a raise is now being driven through promising ground. Small bunches of ore have been found that promise important developments.

Recently a small group of employees at the Eagle & Blue Bell mine endeavored to call a strike, but the movement was a failure. The disgruntled employees made a demand on William Owens, superintendent, for a raise in wages, a larger change-room and lockers, and that no tools be lowered on cages carrying men. The day-shift at the property remained at work, and the trouble was caused by part of the night-shift. Mr. Owens states that no tools are carried on cages along with employees, and that no mining company in the State is more anxious to safeguard its employees than he. Officials state that the present is a most inopportune time for considering wage increases; that every mining company is having its share of trouble, and profits have been cut and slashed by increased operating costs and decreased metal prices. The peak of operating costs has evidently not been reached, as increased freight-rates will make it difficult for many of the smaller properties to weather these difficulties.

At a meeting of the stockholders of the Godiva Mining Co. on August 21, it was voted to accept the proposition

for the sale of the entire holdings of the company. It is understood that some of the older stockholders will retain their interest in the company, but the control will go into other hands. It is expected that the new company will undertake extensive development. At present the deepest working in the mine is a winze that was sunk 150 ft. below the 1200-ft. level.

BRITISH COLUMBIA

TITLE TO GRANBY CONSOLIDATED COMPANY'S CASSIDY COLLIERY IS CLOUDED.

VANCOUVER.—In giving judgment in favor of the Esquimalt & Nanaimo Railway Co. in the case of the railway company v. Wilson & McKenzie, on August 24, Justice Gregory finds that the Granby Consolidated M. S. & P. Co. loses its title to the land on which it has developed and equipped its Cassidy colliery at a cost of more than $2,000,000. The Granby company purchased the property from Wilson & McKenzie, executors to the estate of the late Joseph Ganner and Mrs. Dunlop. The original owners had received the property under the Settlers' Right Act, and were in possession prior to the building of the railway. After purchasing the property, the Granby company applied for and received a crown grant to the coal lands. On February 18, 1918, the railway company brought suit to have the crown grant made null and void, claiming that the land had been given to them with other lands by the Dominion government as a part consideration for building the railway, and that the Provincial government had no right to crown-grant the land. The case will be appealed, and the Granby company will be allowed to work the property, which is outputting 500 tons of coal daily, until judgment is given at the court of final appeal, the Privy Council. About two-thirds of the production of the colliery is used for making coke for the Anyox smelter and the remaining third is sold for domestic purposes.

PRINCE RUPERT.—Four days of almost continuous heavy rain following closely on another storm that had completely saturated the ground played sad havoc with railroads in the Portland Canal and Alice Arm mining districts. Four bridges on the Portland Canal short line, crossing creeks tributary to the Bear river, were washed away and in several places the embankments were badly eroded. The Salmon River wagon-road, too, suffered badly from the effects of the storm. Several embankments were damaged and in places considerable earth was washed onto the Alice Arm-Dolly Varden railway. This, however, has been repaired and ore-trains are moving again. The damage to the Portland Canal line, which only recently had been repaired and put in running order by the Algunican Development Co. for the purpose of taking supplies to the Fitzgerald group, which the company had under option, is of a more serious

A NEW PICTURE OF BINGHAM CANYON. UTAH COPPER MINE IN THE BACKGROUND

nature, and it is doubtful if the line can be operated again this season. The damage affects a number of other properties that were using the line, but parties interested have expressed their intention of continuing operations, notwithstanding the disadvantage under which the storm has placed them. A Victoria syndicate has bonded the Dunwell group, on Glacier creek. A five-foot vein has been stripped for 300 ft. and is said to average $20 per ton in gold, silver, and lead. A new strike has been made at Rivers Bright, at the northern end of Princess Royal island, and 14 claims have been staked. The vein is said to be 40 ft. wide, heavily mineralized, and similar to the Surf Inlet mine ore. The Granby Consolidated M. S. & P. Co. produced 2,400,000 lb. of copper during July, against 2,079,000 lb. in June. This is the first month's work under the new management, and the increased output is said to have been made with a decreased consumption of coke and flux. The company is said to be planning the erection of a 2000-ton concentrating plant, with a view to concentrating the ore and smelting the concentrate in future. The Hidden Creek ore is low grade, and in the past has taken considerable quantities of coke and fluxes to smelt it. For example, last year 647,466 tons of ore required 41,000 tons of limestone, 36,000 tons of quartz, and 56,500 tons of coke, and gave a yield of 19,544,588 lb. copper, 348,408 oz. silver, and 4864 oz. gold. J. H. Meenach, of Seattle, who has the Musketeer group under bond, has stopped work for the season. The new compressor has been erected at the North Star mine, but a shortage of oil-fuel has delayed its being operated.

ONTARIO

NEW ROLLING-MILL PLANNED AT SUDBURY BY THE INTERNATIONAL NICKEL CO.

Sudbury.—The International Nickel Co. is planning the construction of a new rolling-mill at a cost approximating $3,000,000, to be used exclusively for the rolling of monel metal, which is now done at Bayonne, New Jersey. This is understood to be another step in the direction of carrying out all the operations of the company in Canada. The company at present employs 2500 men and is mining about 3000 tons of nickel ore per day, or less than half the capacity of the plant. It is now completing a dam at High Falls, 90 ft. in height, which will hold the water back for a distance of 25 miles to secure a supply of electric power.

Porcupine.—Last week the town of South Porcupine was in imminent danger of destruction from a devastating forest fire, which raged for several days in the immediate neighborhood. The place was only saved by the desperate exertion of the residents who fought the flames continuously for two days and nights until a heavy rainfall brought relief. No reports of damage to mining properties have been received.

The Hollinger Consolidated has found gold at a depth of 2400 ft. in a drill-hole sunk from the 1250-ft. level. The gold content was not high but an encouraging circumstance is that the core of the drill shows that the geological formation on the 1250-ft. level continues at depth. The sinking of the shaft to the 2500-ft. level is being continued. The working force now numbers about 1200 and new men are being taken on every day. One hundred British miners are expected to arrive in September. The company has declared a special dividend of 1% payable September 8, which gave rise to the impression that it had resumed the payment of four-weekly dividends. It is officially stated, however, that the company has no present intention of the kind, but is merely paying dividends as the earnings accumulate.

The Davidson has made important financial arrangements in England by which $1,125,000 has been secured for a program of development, including the sinking of a 3-compartment shaft to a depth of 1000 ft. and the construction of a mill with a daily capacity of 1000 tons, the first unit of which will handle 500 tons daily. It is estimated that a working capital of $300,000 will also be available. The English interests are to receive a block of 1,500,000 shares of treasury stock at 75c. per share on which a substantial payment has been made, the entire amount to be paid by April 1, 1921. The purchasers also receive an option on 1,000,000 vendor's shares at $1 per share, and 1,000,000 more at $1.25.

The sinking of the shaft on the Keora has been considerably delayed by a heavy flow of water but the difficulty was successfully overcome and the 250-ft. level reached. Cross-cutting has been started to open up high-grade ore deposits.

The directors of the Dome Mines have decided to take up the option on the Dome Extension on a basis of one share of Dome Mines for every 30 shares of Dome Extension. A meeting of shareholders has been called for September when the proposal will be submitted for ratification.

Cobalt.—The recent advance in the price of silver has resulted in increasing the output of the Cobalt mines. Shipments last week amounted to 565,193 lb. of ore and 274,837 oz. of bullion. There is less unrest among the miners and if satisfactory conditions continue a largely augmented production during the remaining months of the year is anticipated.

The recently discovered vein on the Bailey, 1½ in. wide of milling ore, has widened out to 5 in. with an increase in silver content to 1500 oz. per ton. It promises well as the find is at the contact.

Blue Mountain.—The old mica mine near the head of Stony Lake, Peterborough county, has been purchased by C. L. Nicholson, of New York, and Norman Miller, of Michigan, who will begin operations shortly and expect to ship 100 lb. of mica per day.

Hyla.—The American Molybdenite Co. has purchased three feldspar properties at Hyla, Haliburton county, and made contracts with a manufacturer of sanitary enamelware in Ohio for the delivery of 35 tons of feldspar per day with a prospect of largely increasing this amount when the equipment now ordered has been installed. It is stated that the feldspar deposits in New England, from which supplies have hitherto been drawn, are becoming exhausted, and that new sources of supply ore sought.

SMELTING-CHARGES ARE INCREASED

The following is quoted from a notice issued by the American Smelting & Refining Co. at Denver. The same policy will be followed with respect to the various plants of the company in other States.

"The general increase in railroad freight-rates allowed by the Interstate Commerce Commission, effective August 26, 1920, adds 33⅓% to the tariff on smelter products; that is, lead bullion and copper matte shipped to refineries, and 35% on shipments of fuel and lime-rock from mines and quarries to our smelting plants. These advances in freight-rates affect, furthermore, the cost of material such as steel, machinery, electrical equipment, etc., used in the operation, and increase the charges for switching intermediary products within the plant. In addition the refining plants have increased charges in proportion to their increased cost.

"The smelting industry of Colorado, already handicapped with refractory ores, high labor costs, and the rapidly mounting costs of fuel and materials, cannot bear this added burden without adjusting metal-deductions and treatment-charges in proportion to the increased freight-charges.

"On lead the deduction from New York sales price will be 27½c. per hundred pounds in addition to the present 50c. deduction and is directly proportionate to the increased freight-rates. This will be effective on all ores shipped on or after August 10, on the assumption that the bullion resulting from the smelting of these ores will not be shipped until after August 26. As a matter of fact the time consumed in the smelting process is from 30 to 60 days, the smelting company suffering a loss on all of its present lead stock.

"The deduction from the electrolytic wire-bar-copper quotation will be 4.7c. per pound, covering increase in freight-rate which on 40% copper in the matte amounts to 33⅓% raise in the metallic copper contents, the balance being increased refining charges. This change is also effective on shipments on and after August 10 for the same reason as indicated above in connection with lead.

"Treatment charges on all ores except oxidized iron fluxes carrying over 30% excess iron received on and after August 26, 1920, will be increased 50c. per ton.

"It is hoped that with the prospect of a steady silver market and improved lead and copper prices and with the closest attention on the part of the mine and smelter to efficiency in operation, that the mining and smelting industries in Colorado will be able to maintain operations throughout this trying period."

ALASKA

Juneau.—During the second quarter of the current year, the Alaska Gold Mines Co. milled 537,754 dry tons, as against 625,890 dry tons for the first quarter. The gross value of the ore was 85c.; the yield was 68c. and the tailing 17c. During the period 646,327 tons of ore was broken in the mine, principally from stopes on No. 8, 9, and 11 levels. A total of 402 ft. of development work was done, consisting of man-way drives and bull-dozing drifts in connection with opening up new stopes. Owing to scarcity of labor, the mill was operated with two shifts in the crushing department, and the concentrating department on a three-shift basis. The number of employees averaged 450 for the quarter, as against 560 for the preceding quarter. The gross value of the bullion and concentrates produced was $364,866; total expenses were $426,537; loss for the quarter, $61,670, as against a loss of $84,585 for the preceding quarter.

CALIFORNIA

Amador County.—The Kennedy Mining Co., whose property is near Jackson, has decided not to make any attempt to unwater its mine and all men, except watchmen, will be laid off immediately. The Argonaut company continues to pump water but under the recent order of the Railroad Commission no hoisting of water in tanks is allowed.

Nevada City.—The order from the Railroad Commission curtailing the use of power for mines in Grass Valley and Nevada City has in no way been changed, although a very determined effort was made on the part of the superintendents to have the order modified to such an extent that the mines could operate on a reduced basis. Even this request was denied, although all are allowed sufficient current to hoist water. The only hope of returning to former conditions rests in early mountain storms. Everyone knows that full resumption is out of the question because of a shortage of labor.——P. F. Roosa, of Washington, D. C., has been in Nevada and Sierra counties interviewing chrome producers who have filed claims for losses incident to the signing of the Armistice.——The Boundary Mines Co., which is erecting a mill just west of the town of Grass Valley, has bought the power-plant at the Osborne Hill mine and is engaged in removing it to the new foundation.——The New England and Sligo quartz claims at Gold Flat near here, have been sold by John V. Hunter and Mrs. C. D. Vincent of San Francisco to the Nevada County Bank.

San Francisco.—C. H. Fry, engineer for the California Metal and Mineral Producers Association, advises operators that they submit in writing any protests or suggestions that they may desire to bring to the attention of the Industrial Accident Commission apropos of the 'Mine Safety Orders' which are to be finally approved on September 17. A public hearing, attended by about 20 mining men was held two weeks ago and a number of suggestions made, which were adopted by the Commission. Any communications received prior to September 17 will be given consideration. Copies of the tentative orders w re distributed among the mine operators some months ago.

COLORADO

Mayday.—Curtet & Moigg, lessees on the Southern Boy, have completed their cross-cut, having penetrated the ore-body for which they have been driving during the past eight months. The vein is 1 ft. wide and assays 2 oz. in gold.——The Mayday Leasing Co. continues operations on the Mayday dumps. Two cars have been shipped to the Durango smelter. The screenings show a value of $16 to $28 with some crude ore assaying as high as $70 per ton in gold and silver.——The cross-cut at the Ruby Gulch has opened two veins, one 4 in. and one 1 ft. wide. The small streak is expected to be rich in gold and silver, as it assayed 100 oz. gold and 200 oz. silver near the surface.——The Jumbo continues shipping from the 800-oz. silver vein recently found in the raise. Another raise is being driven to explore the fissure-vein in the lime strata at the contact.——W. A. Becker, manager of

the Little La Plata and Boren Gulch, is having a compressor installed at the Boren Gulch. Operations at the mine, which discontinued last fall, will be resumed as soon as the compressor is in place. The cross-cut at the Little La Plata, which has been driven continuously since last winter, has not proved as beneficial as was expected. Part of the force employed in driving this tunnel, has been put to work on the vein at the surface, from where lessees have made shipments of ore.

MONTANA

Cooke City.—A fleet of 21 trucks is now hauling ore from the Republic company's property, to Gardiner, where it is loaded into railroad cars. There is more activity in the district this year than ever before. At the McKay properties, the Yellowstone, the Republic mines, Glengarry properties, and Western Smelting & Refining holdings, work has been done in spite of a shortage of miners, and encouraging results are being obtained from development.

Neihart.—Ore shipments are being made at regular intervals from all the mines in the district, with the exception of the Neihart Silver Mines, where all available men have been put on development work. One car of ore has been shipped from the Silver Dyke and another is now being loaded. The Neihart Consolidated has a couple of cars ready for shipment and the Molten is loading a car. Several lessees are working and nearly all are getting out high-grade ore.

MINNESOTA

Mining operations on the iron-mining ranges are on larger scale at present than for some time, mainly on account of relief from the anxiety regarding coal supplies. Some mines are even establishing coal-reserves in preparation for winter stripping operations. Iron ore is moving forward to docks more freely and it is expected the month's shipments will show substantial increase. Twenty steamers are loading at Great Northern docks now and 29 are scheduled to arrive shortly. Eight boats are loading at Messabi docks and 11 are on the way there to load.

NEW MEXICO

Grant County.—The Silver King mine, a former producer, is being unwatered preparatory to development. T. C. McSherry of Silver City, backed by Eastern capital, is in charge of the work. If developments are favorable, a mill is planned and the mine will again be placed on a producing basis. During 1919 some 20-oz. silver ore was milled.

Hidalgo County.—The Great Eagle Fluorspar mine, under lease to Bell & Wright of Silver City, has put a second shift to work to fill contracts with Chicago firms calling for a large output of spar. The product is hauled by motor-trucks to Lordsburg for shipment.

UTAH

Grantsville.—Connection of the working adit of the 'L' Marie Mining Co. with the main working-shaft has been made, according to John V. Long, Jr., general manager. The property of this company is in the Stansbury mountains, about 9 miles from here. Some time ago a shaft was sunk upon a promising outcrop of galena ore, to a depth of 130 ft. An adit was driven along a lime foot-wall and quartz hanging wall through well-mineralized territory. About 15 ft. from the portal a shoot of good ore was penetrated and a winze was sunk; 18 in. of shipping ore is now being followed.

YUKON

Dawson.—The yield of gold from the placer mines in the Yukon valley for 1920 is estimated to total $4,485,000. There has been a considerable shrinkage in the output, owing to the dry season and the decrease in the purchasing power of gold. Six weeks more will wind up the season as the winter freeze will begin then.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

K. S. Twitchell has gone to New York.

E. P. Mathewson has been in Arizona recently.

S. S. Lang, of Houghton, Michigan, is at Magdalena, New Mexico.

L. D. Ricketts has gone from Santa Barbara to Warren, Arizona.

George Hyde, of Wellington, New Zealand, is in San Francisco.

T. H. Jenks has returned to Lake City, Colorado, from Los Angeles.

William Motherwell has moved from Melones, California, to Trail, B. C.

W. J. Kemnitzer, recently at Magdalena, New Mexico, is in San Francisco.

Edward H. Clark, president of the Homestake Mining Co., is at the Fairmont hotel.

T. H. Jenks passed through San Francisco on his way from Los Angeles to Colorado.

Charles Camsell has been appointed Deputy Minister of Mines in the Canadian government.

E. C. Marriage, manager of the assay-office at Pioche, Nevada, has returned from England.

C. H. Poirier, of New York, was in San Francisco on his way from Mexico to British Columbia.

Charles W. Adams, manager of the East Helena plant of the A. S. & R. Co., has been at Salt Lake City.

Robert N. Bell, State Mine Inspector of Idaho, has resigned, and will leave his position on January 1.

E. F. Gordon and **Oscar Hershey** have been examining vanadium properties near Good Springs, Nevada.

Dwight E. Woodbridge has returned to Duluth from a journey of exploration in the Hudson Bay region.

H. S. Gale has resigned from the U. S. Geological Survey to engage in private practice as a mining geologist.

George A. Laird has been appointed manager for the Guiana Development Co. and leaves for Guiana forthwith.

Joseph Chrisman, recently flotation man for the Leadville Mines Co., at Gerlach, Nevada, has moved to Bingham, Utah.

L. E. Grant, general manager for the Braden Copper Co., has returned to Rancagua, Chile, from Denver, where he has been since April.

Y. Fukihara, mining engineer for the Mitsubishi Mining Co., of Japan, has been in Utah visiting mines and metallurgical plants.

Harold Kingsmill, of New York, has been examining properties at Eureka, Nevada. He passed through Salt Lake City on his way home.

T. J. Renaux has been appointed mill superintendent for the Yellow Pine Mining Co., at Good Springs, Nevada, succeeding **M. P. Coonan.**

W. J. Loring has resigned from the firm of Bewick, Moreing & Co., London. He is succeeded as partner in the firm by his son, **Edward A. Loring.**

E. T. McCarthy, of London, a director of the Mountain Copper Co., operating in Shasta county, California, is expected in San Francisco toward the end of September.

J. A. Burgess, who resigned recently as general manager for the United Eastern Mining Co., has opened an office as consulting engineer and geologist in the Mills building, San Francisco.

H. H. Claudet, manager of the Ottawa office of the General Engineering Co., was at Miami most of the summer and passed through San Francisco from Salt Lake City on his way home.

THE METAL MARKET

METAL PRICES

San Francisco, August 30

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.00
Copper, electrolytic, cents per pound	19.00
Lead, pig, cents per pound	9.25—10.25
Platinum, pure, per ounce	$115
Platinum, 10% iridium, per ounce	$165
Quicksilver, per flask of 75 lb	$85
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

August 30.—Copper is quiet but firm. Lead is inactive and lower. Zinc is dull but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Aug. 24	96.00	60.87	July 19	91.04	52.91
" 25	97.00	61.00	" 26	92.39	54.77
" 26	98.00	61.12	Aug. 2	92.85	56.20
" 27	97.75	61.00	" 9	94.58	58.39
" 28	97.12	60.62	" 16	95.39	59.05
" 29 Sunday			" 23	99.12	61.60
" 30	94.00	59.62	" 30	96.61	60.70

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Aug. 24	19.00	July 19	19.00
" 25	19.00	" 26	19.00
" 26	19.00	Aug. 2	19.00
" 27	19.00	" 9	19.00
" 28	19.00	" 16	19.00
" 29 Sunday		" 23	19.00
" 30	19.00	" 30	19.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Aug. 24	9.00	July 19	8.45
" 25	9.00	" 26	8.93
" 26	8.87	Aug. 2	9.00
" 27	8.75	" 9	9.00
" 28	8.75	" 16	9.06
" 29 Sunday		" 23	9.19
" 30	8.75	" 30	8.85

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	....
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.99	5.04	8.55	Nov.	8.05	6.78	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	....
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Aug. 24	8.45	July 19	8.34
" 25	8.45	" 26	8.32
" 26	8.45	Aug. 2	8.11
" 27	8.45	" 9	8.12
" 28	8.45	" 16	8.07
" 29 Sunday		" 23	8.12
" 30	8.45	" 30	8.45

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.22	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Aug. 17	87.00
Aug. 3	88.00	" 24	80.00
" 10	88.00	" 30	85.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	....
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

MONEY AND EXCHANGE

That the Treasury Department can avail itself of the provisions of the Pittman Act to prevent a runaway movement in the silver market was admitted by Raymond T. Baker, Director of the Mint, in discussing the silver outlook. Director Baker is of the opinion that the recent decline in the silver market, due to a lull in buying from the Far East, is only temporary, and that the white metal will again advance.

Referring to the action of European traders and governments in melting silver coin and selling it as bullion, Mr. Baker said: "You must remember that in Germany and Austria their money was at such a discount in the world's money markets that it was practically useless. Their silver coin did have a value, of course, due to its silver content, and in view of the comparatively high price of silver it was natural that they should use their silver coin to purchase the things they needed. But at some time in the future both Germany and Austria must replace the silver coin that has been taken out of circulation, so there is a potential demand for silver from both those countries. The same may be said of Mexico."

Questioned as to the necessity for the passage of a law reducing the fineness of silver coins so as to protect them from sale as bullion in the event of another sharp rise in the price of silver, Mr. Baker intimated that the Treasury Department, through provisions of the Pittman Act, could control the situation.

"In the event of a rise in the price of silver to, say, $1.42 or above, the subsidiary coins of the country would be in danger of being melted," Mr. Baker said. "The parity point of the subsidiary coins is, say, $1.38 and of course the price would have to go above that to cover the cost of collecting and melting the coins and pay transportation charges. The price of silver would have to show a profit or there would be no incentive to melt coins.

"What the Treasury would do in event of such a rise I am not prepared to say, as its action would naturally be governed by conditions existing at the time, but a study of the Pittman Act will show what the Treasury could do. The Pittman Act authorizes the sale of silver bullion derived from melting silver dollars for the purpose of assisting foreign governments at war with enemies of the United States. That now is over. But the Act also authorizes the sale of silver bullion for the purpose of providing silver for subsidiary coinage and for commercial use as well as facilitating the settlement in silver of trade balances adverse to the United States. These provisions have not been changed by the termination of the War.

"Of the silver bullion sold under the Pittman Act we have re-purchased to date approximately 10,000,000 oz. at $1 per ounce, and purchases are being made nearly every day. Should the price of silver go up to above $1.42, what is to prevent the Treasury from re-selling this silver purchased at the market price? Suppose the price went to $1.40 the Treasury could sell 25,000,000 or 50,000,000 oz., and if this amount should be absorbed and the price start to advance again, the Government could sell additional lots up to the full authority of the Pittman Act. And it might be recalled that the Treasury has a reserve of 50,000,000 silver dollars not availed of under the Pittman Act which could be sold to the Director of the Mint for subsidiary coinage at $1 per ounce."

Foreign quotations on August 30 are as follows:

Sterling, dollars:	Cable	3.56¾
	Demand	3.57¼
Francs, cents:	Cable	7.12
	Demand	7.13
Lire, cents:	Demand	4.68
Marks, cents		2.12

Eastern Metal Market

New York, August 25.

The markets are generally quiet and uninteresting with the price tendency, on the whole, easy.

The copper market is very quiet but firm with no change in prices or conditions.

Prices of tin are largely nominal and lower because of absence of demand and lower exchange, as well as a declining London market.

The lead market is manifesting an easing tendency with import metal the feature.

Buying of zinc is not heavy but prices are fairly even.

Antimony is lower.

IRON AND STEEL

To an increasing extent the steel trade is taking account of factors that bear on the future course of demand and of prices, says 'The Iron Age'. While some producers, long used to thinking in terms of a seller's market, talk of passing on the cost increment due to the 40% increase in most iron and steel freight-rates, others dwell on the final effect on their own market of the changes going on in other industries.

With an unwieldy accumulation of unfilled orders in most finished-material lines, such cancellations as have come on automobile and shipyard account have not been a marked factor. But there is the keenest interest throughout the market in any development bearing on the Steel Corporation's price policy for 1921 and railroad buying apparently is waiting for a cue.

The Chicago market, which particularly reflects the railroad situation, has been notably quiet apart from nuts and bolts and wire products. Here and there foundries in that district are curtailing operations and some of them will soon be in need of new orders. Railroad demand there has not yet developed in sufficient volume to offset the curtailment of automobile, tractor, and allied work. Gauged by cancellations and suspended shipments, a number of Detroit automobile plants are operating at about 50% capacity, while two of the largest are running full.

Production and shipments have improved in the leading steel-making centres, and Pittsburgh reports some reduction of mill stocks and nearly a complete clean-up of stored cars in railroad yards.

COPPER

Demand from domestic consumers is very light and the market is lifeless. It is rather surprising, but true nevertheless, that foreign demand is better than domestic but even this is relatively small and confined to orders that appear daily and come from various countries. Deliveries on contracts, however, are much better and as a result consumption is heavier. Ordinarily a buying movement of some proportion was due long before this but the railroad and labor troubles last spring and later delayed this. It is now expected in some quarters that buying on a large scale is likely in the next two or three weeks. Whether this and the increased freight-rates, effective this week, will result in an advance in price remains to be seen, but it is not unlikely. Leading producers of both Lake and electrolytic copper maintain their quotations at 19c., New York, for delivery to October, but are not especially interested beyond this delivery except in special cases.

TIN

The market is featureless and uninteresting and sales have been few and far between. A small business in future-shipment material was put through quietly in the last week, mostly to dealers. Consumers are still uninterested. The price of future shipment Monday was around 46.75c. with the quotation for spot Straits at 46.50c. the same day. Yesterday spot Straits was quoted at 45.50c., New York, which is 2.50c. below the price of a week ago, all these being largely nominal. The decline is due to the fall in exchange and to the lower London market. Yesterday spot Straits in London was £271 15s. per ton as compared with £288 three weeks ago. Arrivals thus far this month have been 3705 tons with 5395 tons reported afloat.

LEAD

The price situation in the New York lead market is such that most any estimate of the market is justifiable. Prompt and early-delivery metal has sold from 9 to 9.37½c. and import lead has changed hands at as low as 8.50c., New York, duty paid. The import supply seems to be the key to the situation here. It is authoritatively and conservatively estimated that at least 6000 to 8000 tons has been contracted for importation from England and some of this has arrived. The import cost of this varies according to the conditions in each case. Consumers realize the situation and are holding off. As a result demand has slackened and the market is quiet. The leading interest maintains its quotation at 8.75c., St. Louis, or 9c., New York, but is understood to be sold-up and to be offering nothing for early delivery.

ZINC

It is unusual to record the fact that zinc, sold or shipped to England, is being offered in this market for re-shipment, but this is the peculiar situation. Some of this metal has been sold at 8c., New York. Just what effect this is to have on the future of the market is not easy to say. Sooner or later, however, the British market must strengthen and relieve the pressure here. Therefore the effect of this import movement is small and the general market is strong with prime Western quoted and sold at 8.10c., St. Louis, or 8.45c., New York. Demand is light with galvanizers apparently well supplied for nearby needs. Production is low and stocks are not heavy, which is one element of strength in the market.

ANTIMONY

The market is quiet with wholesale lots for early delivery quoted at 7c., New York, duty paid. Jobbing lots are obtainable at ¼c. to ½c. higher.

ALUMINUM

The leading interest is quoting wholesale lots of 98 to 99% pure at 34.90c. per lb. f.o.b. producer's plant, while other sellers are asking 32 to 33c.

ORES

Tungsten: More inquiry is reported, developed largely by the low and attractive prices which are nominally $5 to $5.50 per unit for wolframite and $6 to $6.50 for scheelite. It is expected that a fair business will result in the near future.

Ferro-tungsten is quoted around 90c. per lb. of contained tungsten.

Molybdenum: No new business is recorded and quotations are nominal at 65 to 75c. per lb. of MoS_2 in regular concentrate.

Manganese: The market is lower with Indian ore offered at 65c. per unit, seaboard, but no business is yet reported. Former asking prices were 75c. per unit.

Manganese-Iron Alloys: Ferro-manganese has declined decidedly, due to offerings by some British producers at $170, seaboard, for delivery into Jun 1912. American producers have met this figure which will make the delivered American price $170 plus the freight from the seaboard to point of consumption. Some business has been done at the new price. The spiegeleisen market is strong but not active at $80 to $85, furnace, for any delivery. Supplies are not large because production has not been heavy this year.

Dividends From Mines, United States and Canada

UNITED STATES

Company and situation	Metal	Shares issued	Par value	Paid in 1920	Total	*Latest dividends—Date	Per share
Ahmeek, Michigan	copper	200,000	$25.00	$200,000	$2,400,000	June 30, 1920	$0.50
Alaska Mexican, Alaska	gold	200,000	5.00	.....	3,507,381	Nov. 29, 1915	0.10
Alaska Treadwell, Alaska	gold	200,000	25.00	.....	15,785,000	May 29, 1916	0.50
Algomez, Michigan	copper	100,000	25.00	.....	2,850,000	Mch. 31, 1919	1.00
American S. & R., U. S. and Mex.	c.l.g.s.z.	609,980 (com.)	100.00	1,219,960	116,667,005	June 15, 1920	1.00
		500,000 (pfd.)	100.00	1,750,000	com. and pfd.	June 15, 1920	1.75
		193,120 (com.)	25.00	.....	.....	.....	.....
Am. Z. L & S., Missouri and Tenn.	c.l.z.s.g.	96,560 (pfd.)	25.00	289,680	5,903,300	May 1, 1920	1.50
Anaconda, Montana	c.z.s.g.	2,331,250	50.00	2,331,250	167,779,375	Feb. 20, 1920	1.00
Argonaut, California	gold	200,000	5.00	.....	1,970,000	Dec. 25, 1919	0.05
Atolia, California	tungsten	100,000	1.00	.....	5,264,500	Dec. 14, 1918	0.50
Arizona, Arizona	copper	1,519,896	5s.	227,000	2,713,728	Aug. 31, 1919	0.18
		316,530 7% pfd.	...	53,840	21,486,004	.....	.....
Arizona Commercial, Arizona	c.g.s	265,000	5.00	.....	1,086,500	Oct. 31, 1918	0.50
Barnes-King, Montana	gold	400,000	5.00	40,000	420,000	May 15, 1920	0.05
Bingham Mines, Utah	l.s.g.	150,000	10.00	.....	600,000	Sept. 30, 1919	0.25
Bunker Hill & Sullivan, Idaho	l.s.	327,000	10.00	981,000	24,212,250	July 3, 1920	0.25
Butte & Superior, Montana	z.s.l.	290,184	10.00	.....	16,940,258	Sept. 1917	2.50
Butte Copper & Zinc, Montana	z.s.l.mn.	411,700	5.00	.....	300,000	July 30, 1918	0.50
Caledonia, Idaho	l.s.	2,605,000	1.00	130,250	4,612,950	July 5, 1920	0.01
Callahan Zinc & Lead Co., Idaho	z.l.s.	325,000	10.00	376,303	7,342,385	June 30, 1920	0.50
Calumet & Arizona, Arizona	copper	642,521	10.00	1,285,042	44,345,429	June 21, 1920	1.00
Calumet & Hecla, Michigan	copper	100,000	25.00	500,000	152,250,000	June 30, 1920	5.00
Centennial, Michigan	copper	90,000	25.00	.....	360,000	Dec. 31, 1918	1.00
Cerro Gordo, California	l.z.s.	1,000,000	1.00	.....	300,000	Jan. 15, 1918	0.05
Champion, Michigan	copper	100,000	25.00	.....	25,250,261	Dec. 15, 1919	6.40
Chief Con., Utah	l.z.s.g.c.	884,232	1.00	176,840	1,694,671	Aug. 2, 1920	0.10
Chino, New Mexico	copper	869,980	5.00	652,486	29,665,468	June 30, 1920	0.37½
Columbus-Rexall, Utah	c.s.g.	586,234	1.00	.....	14,600	Dec. 30, 1918	0.02½
Con. Arizona Smelting, Arizona	c.g.s.	1,663,000	5.00	.....	498,900	Dec. 17, 1918	0.05
Copper Range, Michigan	copper	395,000	25.00	394,416	26,801,135	June 15, 1920	0.50
Cresson, Colorado	gold	1,220,000	1.00	244,000	8,735,162	June 10, 1920	0.10
Daly, Utah	l.s.g.	150,000	20.00	30,000	3,157,500	April 1, 1920	0.10
Davis-Daly, Montana	copper	600,000	10.00	150,000	900,000	Mch. 20, 1920	0.25
Dragon Con., Utah	c.l.s.g.	1,875,000	1.00	37,500	206,250	April 25, 1920	0.01
Ducktown, Tennessee	copper	198,000	4.80	.....	2,678,702	May 1917	0.96
Eagle & Blue Bell, Utah	l.c.z.s.	893,146	1.00	89,315	1,339,719	April 20, 1920	0.10
East Butte, Montana	copper	421,849	10.00	.....	1,687,396	Dec. 31, 1919	0.50
Electric Point, Washington	lead	793,750	1.00	23,812	325,437	July 1, 1920	0.03
Elkton Con., Colorado	gold	616,884	1.00	.....	3,579,460	May 1915	0.02
Empire Idaho	copper	1,000,000	1.00	.....	300,000	June 30, 1918	0.03¾
Engels, California	copper	1,791,926	1.00	.....	698,684	Oct. 19, 1918	0.01½
Federal M. & S., Idaho	l.z.s.	pfd. 120,000	100.00	400,000	15,304,246	June 15, 1920	1.75
First National Copper Co., Cal.	copper	600,000	5.00	.....	660,000	Feb. 25, 1919	0.15
General Development, U. S.	.....	120,000	25.00	120,000	4,973,917	May 20, 1920	0.50
Golden Cycle, Colorado	gold	1,500,000	1.00	200,000	9,438,000	May 1920	0.05
Goldfield Con. Mines, Nevada	gold	3,559,148	10.00	.....	29,177,789	Dec. 31, 1919	0.05
Grand Central, Utah	l.s.	600,000	1.00	.....	1,858,000	Dec. 23, 1919	0.02
Hecla, Idaho	l.s.	1,000,000	0.25	350,000	8,205,000	June 28, 1920	0.20
Homestake, South Dakota	gold	251,160	100.00	.....	41,292,124	Sept. 25, 1919	0.50
Inspiration, Arizona	copper	1,181,967	20.00	3,545,902	36,619,768	April 20, 1920	1.50
Iron Blossom, Utah	l.s.g.	1,000,000	0.10	50,000	3,275,000	April 26, 1920	0.02½
Iron Cap, Arizona	copper	142,100	10.00	35,525	996,367	Mch. 18, 1920	0.25
Isle Royale, Michigan	copper	150,000	25.00	.....	2,025,000	Aug. 30, 1919	0.50
Jim Butler, Nevada	s.g.	1,718,021	1.00	.....	1,151,074	Aug. 1, 1918	0.07
Judge M. & S., Utah	l.z.c.s.g.	480,000	1.00	120,000	2,490,000	July 1, 1920	0.12½
Kennecott, Alaska	copper	2,786,679	5.00	2,786,679	52,110,275	June 20, 1920	0.50
Liberty Bell, Colorado	gold.	133,560	5.00	40,067	2,701,026	June 30, 1920	0.10
Lucky Tiger, Sonora, Mexico	g.s	715,337	10.00	679,570	6,825,770	July 20, 1920	0.15
Magma, Arizona	copper	240,000	5.00	.....	1,704,000	Jan. 6, 1919	0.50
Mass Con., Michigan	copper	100,000	25.00	.....	486,585	Aug. 15, 1917	1.00
Miami Copper Co., Arizona	copper	747,114	5.00	747,114	22,209,843	May 15, 1920	0.50
Mohawk, Michigan	copper	100,000	25.00	300,000	9,425,000	May 1, 1920	1.50
Nevada Con., Nevada	copper	1,999,457	5.00	999,728	46,268,752	June 30, 1920	0.25
Nevada Packard, Nevada	silver	1,164,492	1.00	.....	110,627	April 20, 1919	0.02
Nevada Wonder, Nevada	s.g.	1,500,000	1.00	.....	1,519,005	May 21, 1919	0.05
New Cornelia, Arizona	copper	1,800,000	5.00	450,000	900,000	May 25, 1920	0.25
New Idria, California	quicksilver	100,000	5.00	.....	2,705,000	Jan. 1, 1919	0.25
New Jersey Zinc, New Jersey	zinc	350,000	100.00	2,800,000	3,500,000	May 1920	4.00
North Butte, Montana	c.s.g.	430,000	15.00	.....	14,657,000	Oct. 28, 1918	0.25
North Star, California	gold	250,000	10.00	.....	5,002,190	June 28, 1919	0.40
Old Dominion, Arizona	c.s.g.	297,071	25.00	.....	14,405,260	Dec. 31, 1918	1.00
Ontario Silver, Utah	s.l.	150,000	100.00	.....	14,157,500	Jan. 4, 1919	0.50
Osceola, Michigan	copper	96,150	25.00	96,150	13,887,975	June 30, 1920	0.50
Phelps Dodge, Ariz., N. Mex., Mex.	c.s.g.	450,000	100.00	2,250,000	86,846,527	April 1, 1920	2.50
Portland, Colorado	gold	3,000,000	1.00	105,000	11,602,080	July 20, 1920	0.01½
Quincy, Michigan	copper	110,000	25.00	110,000	27,002,500	Mch. 29, 1920	1.00
Ray Con., Arizona	copper	1,577,179	10.00	788,590	24,624,031	June 30, 1920	0.25
Shannon, Arizona	copper	300,000	10.00	.....	1,425,000	Nov. 15, 1917	0.25
Shattuck, Arizona	c.l.s.g.	350,000	10.00	87,500	7,612,500	Jan 20, 1920	0.25
Silver King Coalition, Utah	l.s.	1,250,000	5.00	.....	15,198,560	Jan. 1, 1918	0.15
Silver King Con., Utah	l.s.c.g.	850,537	1.00	.....	1,562,705	April 1, 1918	0.10
St. Joseph Lead, Missouri	lead	1,409,466	10.00	1,409,466	20,275,107	June 21, 1920	0.50
Success, Idaho	l.s.	1,500,000	1.00	.....	800,969	July 1916	0.03
Tamarack & Custer, Idaho	l.s.	1,776,500	1.00	53,295	515,125	Dec. 25, 1919	0.03
Tennessee Copper, Tennessee	copper and acid	391,498	no par value	.....	392,817	May 15, 1918	1.00
Tintic Standard, Utah	l.s.	1,174,500	1.00	234,940	1,186,822	June 30, 1920	0.10
Tomboy, Colorado	g.s.	310,000	£1	.....	4,074,200	June 28, 1918	0.12½
Tom Reed, Arizona	gold	909,555	1.00	54,573	2,810,535	Mch. 20, 1920	0.06

*These figures include dividends payable on or before June 30, 1920.

Abbreviations: g. = gold, s. = silver, c. = copper, l. = lead, z. = zinc, n. = nickel, mn. = manganese.

Note: Companies not included in the above list are requested to submit details. Changes in capitalization and new dividends will be entered on receipt of the information. This table will be published quarterly. Corrections are invited.

Company and situation	Metal	Shares issued	Par value	Paid in 1920	Total	Latest dividends: Date	Per share
Tonopah Belmont Dev., Nevada	s.g.	1,500,000	1 00	75,000	10,118,063	Jan. 1, 1920	0.05
Tonopah Extension, Nevada	s.g.	1,282,801	1.00	129,271	2,490,620	July 1, 1920	0.05
Tonopah Mining, Nevada	s.g.	1,000,000	1.00	.....	14,875,000	Oct. 21, 1919	0.15
United Eastern, Arizona	gold	1,363,000	1.00	572,460	2,726,000	July 28, 1920	0.15
U. S. S. R. & M., U. S., Mexico	l.z.s.g.	com. 351,115 / pfd. 486,350	50.00	1,053,345	14,086,874	July 15, 1920	1.50
			50.00	851,113	24,030,155	July 15, 1920	0.87½
United Verde Copper, Arizona	copper	300,000	no par value	900,000	54,197,000	June 10, 1920	1.50
United Verde Extension, Arizona	copper	1,050,000	0.50	1,050,000	10,605,000	May 1, 1920	0.50
Utah Apex, Utah	c.l.s.g.	528,200	5.00	.....	1,122,425	Nov. 11, 1918	0.25
Utah Con., Utah	c.l.s.g.	300,000	5.00	.....	12,810,000	Mch. 25, 1919	0.25
Utah Copper, Utah	copper	1,624,490	10.00	4,873,470	106,636,193	June 30, 1920	1.50
Utah Metal, Utah	l.c.g.s.	691,588	1.00	.....	895,734	Dec. 10, 1917	0.30
Vindicator Con., Colorado	gold	1,500,000	1.00	15,000	3,847,500	Jan. 24, 1920	0.01
Wellington Mines, Colorado	l.z.	1,000,000	1.00	.....	1,950,000	Jan. 2, 1919	0.10
West End, Nevada	s.g.	1,788,486	5.00	178,848	1,251,940	June 5, 1920	0.10
Wolverine, Michigan	copper	60,000	25.00	30,000	10,250,000	Jan. 2, 1920	0.50
Yellow Pine, Nevada	s.l.	1,000,000	1.00	60,000	2,563,008	June 25, 1920	0.03
Yukon Gold, Alaska, Cal., Nev.	gold	3,500,000	5.00	.....	9,858,110	June 1918	0.02½
CANADA							
Belmont Surf Inlet, British Columbia	g.c.	2,500,000	1.00	125,000	375,000	July 1, 1920	0.05
Comstock, Ontario	silver	800,000	5 00	200,000	9,740,000	May 1, 1920	0.12½
Con. M. & S., British Columbia	l.c.z.s.g.	419,098	25.00	526,685	6,046,226	April 2, 1920	0.62½
Crown Reserve, British Columbia	silver	2,000,000	1.00	.....	8,300,000	Dec. 30, 1916	0.05
Dome Mines, Ontario	gold	4,000,000	10 00	200,000	1,700,000	July 1, 1920	0.25
Florence, British Columbia	l.s.z.	1,100,000	1.00	.....	35,300	April 20, 1919	0.01½
Granby Con. M. S. & P., B. C.	c.g.s.	150,004	100.00	.....	10,662,837	May 1, 1919	1.25
Hedley, British Columbia	gold	240,000	10 00	.....	2,460,000	June 30, 1919	0.10
Hollinger, Ontario	gold	4,920,000	5.00	738,000	11,104,000	June 16, 1920	0.05
Howe Sound, B. C. and Mexico	copper	1,984,150	1.00	99,208	793,661	Jan. 15, 1919	0.05
International Nickel, Ontario	n.c	com. 1,673,384 / pfd. 89,126	25.00	.....	52,276,984	Dec. 1, 1918	1.00
			100 00	267,378	7,887,537	May 1, 1920	1.50
Kerr Lake, Ontario	silver	600,000	4.00	.....	9,385,000	July 3, 1919	1.00†
Lake Shore, Ontario	gold	2,000,000	1.00	40,000	240,000	June 18, 1920	0.02
La Rose Mines, Ontario	silver	1,500,000	1.00	.....	7,505,410	April 15, 1918	0.20
McKinley-Darragh, Ontario	silver	2,247,692	1.00	134,861	5,821,522	July 1, 1920	0.03
McIntyre, Ontario	gold	3,640,283	1.00	364,028	1,812,641	May 1, 1920	0.05
Mining Corp., Ontario	silver	1,660,050	5.00	415,012	6,943,630*	June 15, 1920	0.12½
Nipissing, Ontario	silver	1,200,000	5.00	900,000	20,340,000	July 20, 1920	0.25
Porcupine Crown, Ontario	silver	2,000,000	1.00	.....	840,000	June 1, 1917	0.06
Rambler-Cariboo, British Columbia	l.z.s.	1,750,000	1.00	.....	560,000	Feb. 15, 1919	0.01
Standard, British Columbia	l.z.s.	2,000,000	1.00	.....	2,700,000	Oct. 15, 1917	0.05
Temiskaming, Ontario	silver	2,500,000	1.00	100,000	2,225,000	Jan. 31, 1920	0.04
Tough-Oakes, Ontario	gold	531,500	5.00	.....	398,625	Jan 15, 1917	0.12½
Trethewey, Ontario	silver	1,000,000	1.00	.....	1,211,999	Jan. 2, 1919	0.05

*Of this sum, $1,652,260 was paid by the individual companies prior to their amalgamation in 1914.

†This is a capital distribution, and reduces the par value of the stock from $5 to $4, corresponding to a reduction in total capitalization from $3,000,000 to $2,400,000.

Company Reports

BUTTE & SUPERIOR MINING CO.

Report for the quarter ended June 30, 1920.

Property: mine and mill at Butte, Montana.

Operating Officials: Charles Bocking, general manager; E. V. Daveler, general superintendent; Angus McLeod, mine superintendent; F. M. Jardine, mill superintendent.

Financial Statement: income, $769,431; operating costs, $940,433; net operating loss, $147,006. Corresponding figures for previous quarter were $1,750,770, $1,123,514, and $627,256, net profit instead of loss.

Dividends: none during 1920; total to date, $16,940,258.

Production: ore mined during the quarter was 82,490 tons, at a mining cost of $7 per ton, against 130,582 tons mined at a cost of $5.52 per ton for previous quarter. There was milled 81,619 tons at cost of $3.466 per ton, against 130,204 tons at cost of $2.61 for previous quarter. The decrease in tonnage treated, with resultant increase in costs, was due to unsettled labor conditions during the entire quarter, which affected both mining and milling. A strike called April 19 resulted in a shut-down until May 5, when operations were resumed on a limited scale. Operations were being conducted on nearly a normal basis toward the end of the quarter.

DOME MINES CO.

Report for the year ended March 31, 1920.

Property: gold mines and mill in the Porcupine district, Ontario.

Operating Officials: C. D. Kaeding, general manager; H. P. Dependier, acting general manager; C. W. Dowsett, mill superintendent.

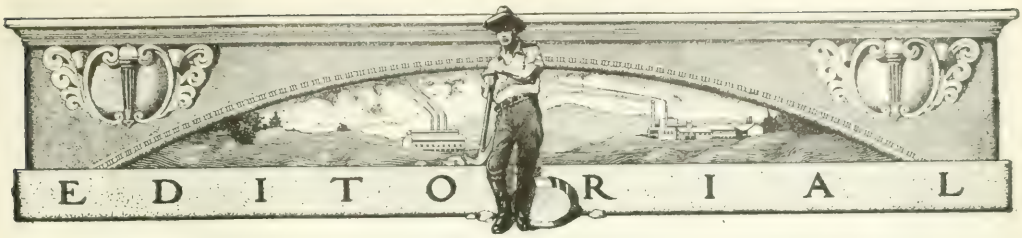
Financial Statement: earnings from sale of bullion, $1,773,374. Cost of mining, $315,873; milling, $311,500, which with miscellaneous costs totaled $930,762. Net operating, $842,612. Miscellaneous income, $109,372; profit for the year, $951,984. After charging off depletion and depreciation, $351,814 was credited to surplus.

Dividends: total to date, $1,600,000.

Development: work was curtailed because of inability to obtain adequate supply of efficient miners. Broken ore in the mine is 251,352 tons. Work by diamond-drills from the 10th level disclosed ore at depths ranging to 216 ft., the holes being at approximately 45°. Ore-reserves are sufficient to promise production for at least three years.

Production: 270,080 tons of ore milled yielded bullion worth $1,773,374, the average value being $6.566 per ton. Cost of milling was $1.153 per ton, and the extraction was 94.295% of the gold. A reverberatory furnace was built to smelt cyanide-precipitate, the increasing copper content of the product interfering with refining by the old method. The ore-handling underground has been simplified with resultant economy.

The Davis-Daly Copper Co. during the three months ended June 30, 1920, shows gross receipts of $311,034; expenditures, $325,035; loss, $14,001. This compares with net profits of $109,283 in the first quarter of this year and net of $161,255 in three months ended December 31, 1919. The report says that cross-cutting on the 2700-ft. level should within a week or two reach the orebody on the downward extension from the 2500-ft. level. Tonnage hoisted for the quarter amounted to 17,414 tons, producing 2,197,936 lb. of copper and 91,238.5 oz. of silver. The average assay of ore shipped for the period was 7.07% copper and 5.88 oz. of silver to the ton.



T. A. RICKARD, - - - - Editor

HOW our bureaucracy has grown during the War and how little it has been decreased since the Armistice is shown by the fact that the Federal government has 760,110 civil employees today as against 420,752 in 1913.

MOVEMENTS of gold and silver bullion indicate the course of international trade. For example, during the first ten days of August our imports of gold amounted to $8,071,045, of which $6,664,234 came from the United Kingdom. During the same ten days we exported $8,430,743, of which $8,114,503 went to Asia. Exports of gold from the United States from January 1 to August 10 totaled $225,719,396, or $73,379,406 in excess of imports. The excess is a sign of increased importation from abroad, and the liquidation of some of our foreign loans. Silver imports during the same period, January to August, amounted to $64,016,269, as against exports aggregating $88,470,846.

SENATOR HARDING and Governor Cox have been quizzed by the American Association of Engineers on several matters of immediate interest to our profession. The Governor answered glibly that he gave "an unequivocal 'yes' ", whereas the Senator was characteristically equivocal. Yet the answer of one is worth about as much as that of the other, at least on the main query, which referred to the creation of a Federal Department of Public Works. It is more than probable that in the childish effort to saddle the opposing party with financial corruption neither has had time to consider such an important subject as the co-ordination of the engineering activities of the national administration.

A PIECE of quartz containing $3000 worth of gold is on exhibit, says a San Francisco newspaper. It came from the Alcalde mine at Grass Valley, California. The quartz, it is reported, "runs in ribbon structure on a true-fissure vein, and is not merely a pocket". We hope it is not; we suspect that it is. The present writer took out $3000 worth of gold in two hours in the Rathgeb mine near San Andreas, in Calaveras county, when a young man. He did not know much, but he suspected that it *was* a 'pocket'. Unfortunately such sweet ore does usually occur in small quantity and is so much more concentrated than the run-of-mine that the miner recognizes its sporadic character by calling it a 'pocket'. All of us love ribboned quartz and true-fissure veins, for are they not the hall-mark of persistence? Nevertheless, it seems to be one of the ordinances of nature to regulate the size of orebodies more or less in inverse proportion to their richness. To expect specimen ore to exist in large or continuous masses is the triumph of hope over experience.

ONLY $1,130,752 worth of silver was exported from this country to India during the fiscal year ended on June 30, as against $214,481,099 in the preceding fiscal year. On the other hand exports of silver to China amounted to $117,570,415 in the last fiscal year, as against $24,571,791 the year before. It is evident therefore that the absorption of silver by China helped to redress the cessation of purchases from India. Adding the exports to the two countries, we find that the Orient took $118,700,167 in the last fiscal year as against $239,052,890 during the previous twelve months. It is no wonder, therefore, that the price of silver fell to 81 cents in May, a drop of 56 cents from the high point last November. Only the purchases under the Pittman Act prevented a further collapse, due, as shown above, to the inability of India to buy, owing to a sudden reverse in the flow of trade.

INTELLECTUAL dishonesty is the curse of world politics, as of similar activities nearer home. 'The Brooklyn Eagle', an excellent newspaper, says that "France has declared herself to be in complete accord with the United States" in regard to Russian-Polish affairs. This is not true. France has hastened to recognize General Wrangel while he is yet recognizable, whereas our government has indicated clearly that it will not go to the support of any Russian faction, however much it may reprobate the so-called soviet regime. The United States and the United Kingdom agree in their decision to keep hands off Russia; and it is a pity that this policy was not followed sincerely long ago—either that, or a whole-hearted and united effort to smash the brigands who pose as communists. At the present time it seems to us a wise decision to let Lenin, Trotzky, and their crew stew in their own juice.

PONZI'S fraud has been fairly well exposed now. He collected ten million dollars from his dupes, simple-minded people who expected to make money quickly on a nebulous scheme based upon the vagaries of international exchange. As a matter of fact, this was a clean

fake, for he spent just six cents upon one international reply-coupon. All he did was to collect the money of his victims and pay back a part of it as dividends. When his 'depositors' and 'investors', as the poor things were called, became suspicious, owing to the much belated action of the proper authorities, he had to face a 'run', during which he returned $5,900,000, besides the $1,000,000 that he had doled out, as 'profit', before the crash came. He spent $84,000 on a house for himself, besides $15,000 in automobiles. He paid $55,000 to a man who held him up, and an equal amount to lawyers. He gave a million dollars in commissions to his agents. At the accounting there remained $1,073,432 in cash at the bank and $658,377 in various stocks. There will be about $1,500,000 for final distribution, which will represent about 50 cents on the dollar to the 'depositors' who failed to get out in time. He has been in jail twice already. His chief asset was impudence, plus the natural fact that the birth-rate among simpletons is large.

USUALLY 'house organs', that is, the publications issued by manufacturers to advertise themselves, are not interesting; they are all that 'literature' should not be; but some of them happen to get into the hands of a competent editor, and then they emerge from the mildew of catalogues into the fresh air of journalism. These preliminary remarks are prompted by the July issue of 'Through the Meshes', the propaganda of the W. S. Tyler Company, of Cleveland. In this little magazine we find the Constitution of the United States, which by itself would be impressive. In addition, we find an appreciation of the book 'Back to the Republic', by Harry F. Atwood, together with sundry timely remarks upon the critical period in which we are living. The essential difference between a republic and a democracy is emphasized, with a view to urging the need for a return to the ideals of the founders of this republic. The Government, both Federal and State, delegates too much power to boards and commissions. The Tyler company has a man that can put ideas through the screen of reason so that only those that have been ground fine by human thought shall pass forth into usefulness.

OBREGON has been elected President of the United States of Mexico. The election aroused but little popular interest and passed quietly, as is usual in Mexico, for the 'election' of a President is generally settled, by bullets rather than ballots, a short time before the electorate is called upon to confirm the practical result of an earlier and much more exciting contest. However, far be it from us to sneer at other people's ways of effecting the selection of a chief executive. In this case the result is satisfactory, because it places in authority a man of intelligence and character. Señor Alvaro Obregon—we do not call him 'General' because, we understand, he desires to be regarded as a civilian—is an 'Americanista', that is, he wishes to live on friendly terms with his neighbors to the north and hopes to have their financial assistance in reorganizing the industrial affairs of his own country. The new President of Mexico speaks the language of the United States well; that in itself augurs for an understanding sympathy, for gentlemen can always be on a friendly footing if they but speak each other's language. We wish him well, and hope that his government will shortly receive recognition from ours. It will be a great blessing to have Mexico restored to order, for not only would we like our nationals to have the opportunity of resuming their mining operations under such laws as the Mexican government may impose fairly, but we are glad that the bogy of annexation has been quieted, at least for a time. Annexation would do more harm to the United States than to Mexico.

LAST week Dr. John C. Merriam, Professor of Paleontology in the University of California, was tendered sundry dinners and receptions by way of friendly farewell before his departure to Washington, where he will assume his new duties as head of the Carnegie Institution. His departure is a real loss to the University and to the State, but it is gratifying that a man of science so sincerely devoted to the cause of research should receive such well-merited promotion to a position of greater importance and wider usefulness. In these days not many of the devotees of science have the courage to stick to the pioneer paths of research when the muddy highways of commercialism promise them greater pecuniary reward. The application of geology to industry has gone so far as to suggest the possibility that unless there is more research there will be but little new science to apply. Many of the fundamental problems of geology are being solved, or are in course of solution, in the Pacific Coast region, notably in our own State of California. We can ill afford therefore to lose such men as Dr. Merriam. Incidentally, it is worthy of remark that paleontology, as a study of evidence on the development of life, floral and faunal, preserved in the rocks, was a principal factor in stimulating the central idea of evolution. It was to Lyell that Darwin owed the first hints of his own great concept, and it is to geology, particularly that part of it concerned with the sequence of rock formations, and of the vestigial record they contain in the form of fossils, that we owe the splendid imaginations of modern science.

THE Utah Public Utilities Commission, after a hearing lasting several days, has excepted freight-rates on intra-state shipments of ores, including coal, from the increase of 25% that it had authorized on other commodities in conformity with the action of the Interstate Commerce Commission. During the hearings, representatives of the mining companies showed that the increase of 20% granted by the Director-General of Railroads in 1918 had resulted in the closing of a number of mines that yielded ore of comparatively low grade; and figures were presented to indicate that a further increase at this time would be followed by the suspension of shipments from a large number of mines, with attendant hardship on various mining communities throughout the State. It was argued that the direct increase in the cost of shipping ore was only one of the burdens that the new rate-

schedule will place upon the operating companies. The transportation of fuel and fluxing material to the smelters and the shipment of bullion to Eastern refineries must be paid for in large measure by the producer, and increased freight-rates will likewise be reflected in the cost of mine supplies. The total average additional expense for the mining company, according to estimates presented, would amount to $1.63 per ton. Mr. Walter Fitch, of the Chief Consolidated company at Eureka, testified that his company had shipped 20,000 tons of ore worth $39.44 per ton during the second quarter of the year at a loss of $0.316 per ton. Evidence given by other officials corroborated the statement of Mr. Fitch that an increase in rates would be a serious detriment to the industry. The railroad companies, when given an opportunity to present their side of the case, took the ground that the purpose of the proceedings was to arrange for increased revenue in an emergency, and should not be viewed in the light of a rate-making hearing. On this basis they asked that the horizontal increase be allowed and that particular questions as to rates be settled later. We surmise that the carriers recognize the importance of the mining industry to the welfare of the State; that they appreciate the position of the mining companies, and realize that many of them cannot operate if costs continue to advance. Whether properly or not, freight-rates have always been based to a large extent on 'what the traffic will bear' and apparently some of Utah's mining enterprises are already pretty well burdened. Since many of the smelters are in Utah, companies shipping ore from neighboring States, as, for instance, Pioche in Nevada, will doubtless feel badly treated at being compelled to abide by the ruling of the Federal Commission. Traffic officials admit that the refusal of the various State commissions to authorize parallel increases in intra-state rates may have serious consequences, and, if general, will defeat in a measure the purpose of the original award.

Colorado School of Mines

We have received a copy of the report on the Colorado School of Mines as submitted by a committee of inquiry appointed by the American Association of University Professors. Our readers are aware that the mining school at Golden has been the victim of recurrent scandals; they know that it has produced many mining engineers of high character and ability; they regret that the good repute of the School should be clouded repeatedly by ructions variously between the trustees, the faculty, the students, and successive presidents; and they will be interested in learning what report a competent committee of inquiry has made. We have read the complaints submitted by numerous professors and ex-presidents of the institution, together with the defence made by the trustees, and find ourselves in hearty agreement with the findings of the committee, which, in brief, are that Dr. Victor C. Alderson, who was president from 1903 to 1913, and was re-appointed in 1917, dismissed "strong teachers of professional rank and of long service . . . without charges, hearing, or adequate warning; that he lowered the standards of scholarship . . . by compelling members of the faculty to change [the] grades of students, especially of those who had influential relatives". Next, it is found that individual trustees "weakened the authority of the faculty by interfering in matters of discipline . . . and that President Parmelee was dismissed chiefly on account of the firm attitude he took in resisting interference on the part of the board [of trustees] with the faculty's responsibility for maintaining discipline and proper educational standards". The reply made by the trustees to "the sworn and detailed statements of former professors" is "uncandid and evasive"; in effect, it "admits the gravest of the charges as if they were of no serious importance". In concluding, the report says: "The conditions which were brought out in this investigation, unless remedied without delay, will prove most disastrous to the future of the School. To attract and to retain teachers of superior qualifications, an institution must protect them from administrative tyranny and from interference with their personal functions and responsibilities, and must maintain such standards as will permit men of character to enter and to remain in its service without loss of professional self-respect. This can only be accomplished if the authorities of the State of Colorado will appoint trustees who are competent to select and to support a president who has the proper educational ideals".

In short, what is needed is that the pressure of public opinion compel the Governor to select suitable trustees or that the law regulating the choice be so changed that it will be made intelligently and conscientiously by some other authority. We visited the School at the time of the students' strike in 1917 and realized the unfairness meted to Mr. H. C. Parmelee, as stated in our issue of June 16, 1917. The board of trustees at that time consisted of five, two of whom were graduates of the School and well fitted for their responsibility, but the majority of three consisted of a reporter on one of the Denver papers, a small banker living at Golden, the representative of the local boarding-houses and tradespeople, and a mining 'magnate', who failed to attend any of the meetings of the board until a crisis supervened, and then only added to the confusion by talking one way and acting another. The conditions that Mr. Parmelee had to face provoke satire. The reporter trustee, 'Cap.' Smith, actually authorized a citizen of Golden, entirely without official connection with the School, to tell the striking students to return to work and that "their suspended colleagues would be reinstated". In 1897, 1902, 1903, 1905, 1915, 1917, and in 1920, the School suffered from unfortunate publicity arising from domestic troubles. Sometimes it has been a president who has shown no decent consideration for the members of his faculty; sometimes it has been gross interference by the trustees with the authority of the faculty; and sometimes, in consequence, it was the students who proved mutinous. If the School is to survive, it must receive the best attention of the citizens of Colorado immediately. Of course, the slime of politics is over it all. The majority of the board of trustees are appointed by a politician, the Gov-

error. It may be right that the Governor should have some say in the administration of a State institution; he might be allowed to select the minority of two. We suggested in 1917 that some of the trustees be selected *ex officio*, for example, the president of the Colorado Scientific Society or the chairman of the local section of the American Institute of Mining Engineers. The alumni of the School elect two members, and they have been well chosen. The main thing is to divorce the School from local politics—and meretricious newspapers. We hope that the mining fraternity in Colorado will arouse itself to an exertion of whatever influence it may command in order to safeguard the School, which evidently is on the rocks. The Colorado School of Mines has done too well to be jettisoned; it deserves the best help of the mining profession in the hour of danger.

The Great Steel Strike

This is the title of a book by William Z. Foster on the steel strike of 1919. We read in the 'New Republic' that it was "a book of the first importance in American labor history" and we thought it well to read what one of the leaders of the strike had to say about it, so we ordered the book and read it carefully. Mr. Foster was the organizer of the strike and was responsible for the management of it as long as it lasted, that is, from September 22, 1918, to January 8, 1920. Officially he was secretary-treasurer of the committee that had charge of the fight. His book, of course, is an *ex parte* statement of the case, but it has value as giving us one side of the story; as a narrative it is not so "swift, vivid, and illuminating" as the reviewer in the 'New Republic' led us to expect, but it does throw light on a great industrial struggle and in parts is sufficiently candid to uncover the purpose and program of the left wing of the labor party. If Mr. Gary, on the other side, would give us his version of the affair we would be much nearer to an intelligent understanding of the causes and conditions governing the struggle, and any future struggle of the same kind, for the chief message of the Foster book is to threaten a recurrence of the industrial upheaval at an early date. The author says: "When the opportune time comes, which will be but shortly, the next big drive will be on"; and he promises that "the great steel strike of 1919 will seem only a preliminary skirmish when compared with the tremendous battles that are bound to come, unless the enslaved steel workers are set free". These quotations give a fair idea of the style and temper of the book.

Mr. Foster reviews the earlier strikes of 1892, 1901, and 1909, all of which failed. The effort to unionize the steel workers was resisted successfully by their employers. The European war afforded an opportunity to organize the workers. In 1918 Mr. Foster had been organizing unions in the packing-house industry of Chicago and was looking for an opportunity to use his energies in a new field. He suggested to his friends of the American Federation of Labor that "the organization of the vast armies of wage-earners employed in the steel industries is vitally necessary to the further spread of industrial democracy in America". As he says, "the idea was to make a hurricane drive simultaneously in all the steel centres that would catch the workers' imagination and sweep them into the unions *en masse* despite all opposition, and thus put Mr. Gary and his associates into such a predicament that they would have to grant the just demands of the men". He counted upon taking advantage of the national necessity: "The war was on; the continued operation of the steel industry was imperative; a strike was therefore out of the question; the steel manufacturers would have been compelled to yield to their workers, either directly or through the instrumentality of the Government". He chuckles at the prospect of carrying out this plan, which was "the logical and practical one". It miscarried, because, although the unions under the American Federation of Labor approved the project, they failed to find the necessary funds. The conspiracy —for it was that, considering the fact that the nation was at war—succeeded only in unionizing some of the steel workers of the Chicago district. In October 1918 the U. S. Steel Corporation announced the adoption of the basic eight-hour day, with 50% extra pay for over-time. That was "a counter-stroke", says Mr. Foster, "which the national movement had been designed to forestall". Thereupon he and his friends moved to the Pittsburgh district and began their campaign of preparing for a strike, by enticing the steel workers into the unions that they organized in the various towns. They deserve credit for persistence, and even courage; for they had to face many obstacles, including "the chronic lack of funds, suppression of free speech and free assembly, raises of wages, multiplicity of races, mass picketing by bosses, wholesale discharge of union men, company unions, discouraging traditions of lost local strikes". Many pages are devoted to a description of the efforts made by local authorities to prevent public meetings: this was done variously by mayors, burgesses, and town councils. That such inhibitions were instigated by the steel companies is quite likely; that in some cases the methods adopted to prevent disorder were technically unlawful is more than probable. The townspeople did not want their quiet disturbed by the ructions of labor agitators, and, like the public generally, wished to be quit of the internecine struggle between the capitalist and the laborer. In many instances a meeting was permitted with the proviso that English only could be spoken. This touches an interesting phase of the struggle. The majority of the strikers consisted of the foreign-born. Omitting the office forces and bosses, "it is exceedingly doubtful if over 25% of the actual workers are American-born whites". So says Mr. Foster; the proportion is more nearly 40%. He continues: "How, then, can a general strike for steel workers be anything else than largely a strike of foreigners". That, of course, is one of its hideous features. The Americans did not favor a strike, partly because most of them belonged to the class of skilled labor, which was well paid. This fact Mr. Foster acknowledges in so many words: "But if the Americans and skilled workers generally proved indifferent union men in the steel campaign, the foreign unskilled workers covered themselves

with glory . . . . They proved themselves altogether worthy of the best American labor traditions". In order to recruit for the unions, it was necessary for the organizers to issue their circulars in four languages at least, usually in six, and the strike call itself was issued in seven languages. Another interesting fact is the aversion of the negro to unionism. "The indifference, verging often into open hostility, with which negroes generally regarded Organized Labor's activities, manifested itself strongly in the steel campaign. Those employed in the industry were extremely resistant to the trade-union program; those on the outside allowed themselves to be used freely as strike-breakers." Of the employees in the steel industry, 4.7% were negroes. They are mostly unskilled laborers, and are chiefly in the blast-furnace department. In the Homestead plants they constituted 12 to 14% of the working force. In that locality only eight out of 1737 negroes joined the union. "In the entire steel industry, the negroes, beyond compare, gave the movement less cooperation than any other element, skilled or unskilled, foreign or native." Worse yet: those on the outside were willing to be used as strike-breakers. Mr. Foster asserts that the steel companies recruited and shipped 30,000 to 40,000 negroes to the mills in order to break the unions. For this, he thinks the unions themselves are largely to blame, because "many of them sharply draw the color line", a discrimination he censures strongly, because it interferes with the plan of organizing all the workers irrespective of color, sex, race, or creed. In this particular, as in others, the steel workers showed much less solidarity than their employers. Although the steel companies independent of the so-called Trust, the U. S. Steel Corporation, had developed various systems of their own for collective bargaining, such as shop-committees and works-councils, in order to circumvent the unions, and although they had gone further than the Steel Corporation itself in correcting some of the abuses that provoked the strike, nevertheless, when the struggle with the labor agitators was once started, they supported Judge Gary to a man. The entire body of employers functioned as a unit; the solidarity of capital exceeded that of labor.

The strike was comparatively free from violence. Regular troops at Gary, militia at Indiana Harbor, and the State Constabulary in Pennsylvania were factors in maintaining order, but there can be no doubt that the workers were orderly chiefly because they were sober. Owing to war-time prohibition, the saloons were closed. Instead of buying drinks, the men bought food. Mr. Foster asserts that prohibition helped to prolong the strike, by conserving the financial resources of the men, many of whom formerly would have spent their savings in drink and then returned to work. Only 20 persons were killed during the strike, and some of these were the victims of criminal violence only indirectly related to the struggle. Mr. Foster, however, claims that "scores of scabs, because of their own or other incompetent workers' ineptness, were roasted, crushed to death, or torn to pieces in the dangerous steel-making processes during the strike". This statement, like others that he makes, may be discounted. For example, the claim is made that the steel workers are under-paid and over-worked. It is true probably of some of them, as in other industries; many work over-time because the processes of steel-making require continuity of human effort in certain operations; the skilled men engaged in these special departments earn from $13 to $21 per shift. Other skilled labor earns $7 to $8 per shift. Common labor gets 45 to 50 cents per hour, or $125 to $140 per month. These were the figures published by the Steel Corporation at the beginning of the strike. Mr. Foster, criticizing the estimate of $87,000,000 as the amount lost by the men in wages during the strike, says that it "bears the earmarks of Steel Trust origin, and is too low". Whereupon he bases his estimate of $112,500,000 upon a rate of "$5 per day per man". Again, in a letter to Mr. Gary, his committee claimed to speak for "the vast majority of the employees in this industry", whereas they had enrolled in their unions only 156,000, out of 500,000. He claims that 365,000 men went on strike, which, he asserts, was 90% effective. These statements are untrustworthy. Even his own story does not support them. The result of the strike renders them highly improbable. But there is one feature of his management that merits admiration, and that is the commissariat which he established with the funds given by other unions. He received $418,141 for the purpose and spent $348,509. At a cost of 9⅓ cents per week per striker he was able for four months to feed those who were destitute—a small minority only, apart from whom the steel workers were able to make "their long hard fight virtually upon their own resources". The cost of the strike to the men, in lost wages, was $112,500,000. Mr. Foster's committee spent $525,702. The cost to the steel companies was "several hundred millions of dollars", says Mr. Foster. To this must be added the loss to the railroads and to the many industries dependent upon either the consumption or the production of the steel companies. The total financial loss is incalculable. But, says Mr. Foster, it was well worth while. "The whole trade-union movement won a great moral victory." "The conclusion is bound to be optimistic and full of enthusiasm for the future." "The next movement will have to win by its own strength, rather than by the vagaries of a newspaper-created public opinion."

Here he places his finger inadvertently on the chief feature of the strike, namely, the stupidly helpless attitude of the public. It is obvious that these blind vendettas waged by obstinate and ignorant men are the negation of civilized life. The attempts of the Strike Committee to obtain a conference with Mr. Elbert H. Gary, the chairman of the finance committee of the U. S. Steel Corporation, and his replies to them exhibit a state of affairs that is intolerable. The matter is treated as if it concerned only these particular employers and their employees, numbering, all-told, only half a million people, whereas it affected vitally a commonwealth of a hundred million people. The ½% menaced the welfare of 99½%. We hold no brief for Mr. Gary; he may be an improvement upon Messrs. Vanderbilt and Baer as an exponent

of capitalism, but he too shows too small a realization of the obligations owed by him and his colleagues to the community in which they conduct their industrial operations and to the commonwealth under whose laws they are permitted to exploit a national resource. The only way to combat the unrestrained egoism and selfishness of the protagonists in such a struggle as the steel strike is to inform the public concerning the facts. Without reliable information the public is helpless; it truly is "damned", as Vanderbilt thought it ought to be. An ignorant and invertebrate public opinion is helpless. Mr. Foster announces that another and a bigger steel strike is assured within a year or two. Mr. Gary says, in effect, "Come on" or "Go to hell" to Mr. Foster. Is the public, that is, the nation as a whole, to wait supinely until the vendetta is resumed? Obviously the proper corrective is the publication of trustworthy data concerning the facts at issue, such as hours of labor, rates of pay, treatment of the men, housing conditions, and the other conditions that determine the reasonable welfare of the workers. The enormous profits made by the steel companies leave them no excuse for disregarding their obligations in such matters. If the information is to be reliable and convincing, it must be unbiased. The President should take the initiative in this matter, which is of national importance. President Wilson did well with his Industrial Conference; his successor can do even better by appointing a committee of inquiry that will command national confidence. The Presidential nominees should be asked their views on the subject.

One more feature of Mr. Foster's book remains to be discussed. At the close he outlines his philosophy frankly. The labor-unions are to be used as a means of establishing the dictatorship of the proletariat; that is Bolshevism; they must act in unison, so as to 'hold up' the entire country if necessary to obtain their demands. They have "surrounded themselves with a sort of camouflage or protective coloring, designed to disarm opposition . . . This is the function of such expressions as 'A fair day's pay for a fair day's work', 'The interests of Capital and Labor are identical', etc. . . . They are for foreign consumption. The fact that those who utter them may actually believe what they say does not change the situation a particle. Most movements are blind to their own goals anyway . . . The trade-unions will not *become* anti-capitalistic through the conversion of their members to a certain point of view or by the adoption of certain preambles; they *are* that by their make-up and methods." The italics are his. He believes that the trade-unions can be made so 'radical', that is, so much in accord with the views of men like himself, that there will be no need for a party of the Left, such as the I. W. W. He complains that the more militant members of the trade-unions have joined the I. W. W., thereby devitalizing the trade-unions, to which he looks for leadership in the industrial war he anticipates with so much confidence and cheerfulness. "In a word", he says, "the progressives must be won over from the idealistic and utopian to the [illegible] point of view . . . Indeed it must be granted that insistence upon the real goal and tendency of trade-unionism will provoke the capitalistic class into greater opposition against the movement. But this will be trebly offset by the added support which the unions will get from the large numbers of militants who now stand apart from them because of lack of understanding. The power of even a few such men, proceeding intelligently along practical lines, is one of the marvels of the labor movement." I quote at some length because it is well to understand the menace conveyed. His "evolutionary" seems to lack an 'r', for he speaks of recent events in England thus: "In England the turning point came ten years ago when she felt the great wave of sentiment for revolutionary unionism then sweeping the world. The question was whether this movement should realize its aims through the old unions or by starting new ones . . . Fortunately, Tom Mann and his colleagues, with a deeper knowledge of trade-unionism, were able to forestall this movement and to direct the strong stream of progressive thought and energy into the old unions. The result was magical. Within two years the great and successful strikes of the transport workers, railroaders, and miners had occurred, and the renaissance of the English labor movement was assured." Yes, and the whole network of English industry was paralyzed for a time by this magic touch, and would have been held by the throat if the public generally had not rallied to the support of the government. Let us hope that nothing so "magical" will happen in our country when Mr. Foster and his friends start their little game of terrorism. A combination of "great and successful strikes" among the railroad hands, the steel workers, and the coal miners, such as he pictures so jubilantly, will be a national calamity too tremendous to be contemplated with philosophic calm. There is one way to prevent it, and that is to create a healthy and intelligent public opinion on this industrial struggle between the corporations and their employees; such a public opinion will react upon both sides and hold them accountable. A public that is ignorant and supine will be trodden underfoot, as it deserves. The moral of Mr. Foster's book is that the Federal authority should order an investigation, ascertain the facts, and take the public into its confidence. By this is meant not an investigation such as was conducted under the auspices of the United States Senate during the strike, when a group of senators went into a room by themselves and summoned sundry witnesses to come before them, but a genuine inquiry conducted by competent men, say, three or five, in the mills and in the communities dependent upon them. The daily press cannot, we regret to say, fulfill this function. Too few owners of newspapers are sufficiently detached to treat the subject without bias. In the region directly affected by the strike the newspapers were controlled or subventioned by one side or the other. The matter is too serious to be left to the vagaries of journalism: it must be made the business of official inquiry. If the public is given reliable first-hand information, it will be competent to exert its proper influence. Without such information, it will be helpless.

The Record for Cheap Mining

The Editor:

Sir—I have only just noticed the very interesting article upon the Bunker Hill enterprise published in your issue of May 29, 1920, in which reference is made to the record in cheap gold mining and milling made by Mr. Bradley at the Spanish mine in Nevada county, California, as described in your issue of October 22, 1887.

Your readers might perhaps suppose that the record in question has remained unbeaten, and it may interest some of them to learn of a still lower record made at a Mexican mine and described in a note at the Richmond meeting of the A. I. M. E. in February 1901 and published in the Transactions, A. I. M. E., Vol. XXXI, pp. 445-449. The figures compare as follows:

	Spanish mine, California		Santa Fe mine, Mexico	
Number of tons	2796		10,274	
Operating costs, cents per ton:				
Mining: Wages	32.4		19.0	
Supplies	5.1		1.5	
		37.5		20.5
Milling: Wages	12.3		9.0	
Supplies	10.7		8.6	
		23.0		17.6
Yield of ore in gold		$1.155		$1.318
Total cost, cents per ton		60.5		38.1
Profit per ton		0.550		0.937

The record made at this Mexican mine 20 years ago remains, I believe, unapproached to this day.

London, July 31. HENRY F. COLLINS.

Two Suggestions on a National Problem

The Editor:

Sir—I have read with interest the letter by M. von Bernewitz on the gasoline and oil situation, and, though there can be no gainsaying the urgent need of discovering a way out of the present difficulty, I do not think it is to be found in the more extended use of producer-gas for raising steam and for use in internal-combustion engines.

Producer-gas is of inestimable value in many metallurgical processes, such as the open-hearth process for converting pig-iron into steel, where the use of a solid fuel is impracticable and where the rapid regulation of the atmosphere of the furnace from oxidizing to reducing, and the reverse, is of paramount importance. Likewise, where convenience is a main consideration, producer-gas has its uses, but as an economical means of burning coal for raising steam or for many metallurgical purposes in which coal-ash does not interfere with the reaction, producer-gas is not in the same class with pulverized coal as a fuel. Theoretically, the combustion of carbon to carbon monoxide produces 2450 calories, the combustion of carbon monoxide to carbonic acid 5630 calories, and the combustion of carbon to carbonic acid 8080 calories. In the manufacture of producer-gas, therefore, that is in the conversion of the carbon of the coal to carbon monoxide, 30% of the heat value of the coal is lost. As a matter of fact, in practice a great deal more is lost, as is proved by the presence of 3 to 10% of CO_2 in producer-gas, but as combustion of coal even in the powdered state is rarely complete, we can afford to be magnanimous, put the one loss off against the other, and assume a loss of only 30% in comparison with the direct combustion of coal. That is bad enough, but it is not all. The nitrogen content of producer-gas ranges from 50 to 60%, with an average in excess of 55%; add to this 5% of CO_2 and we get 60% of inert gas in the mixture, which is a serious drawback when used as fuel for internal-combustion engines, in which the inert gases uselessly occupy valuable space in the combustion chamber. For raising steam, producer-gas has about one-third the calorific power of coal-gas.

The use of coal-gas as a fuel for stationary internal-combustion engines is, of course, far older than the use of gasoline; in fact, I believe I am right in stating that gasoline replaced coal-gas mainly on account of its greater convenience for use in automobiles. So the reversion to coal-gas for the propulsion of automobiles in England while there was a shortage of gasoline during the War was only to have been expected. I should like to explain to Mr. von Bernewitz, however, that the storage of the gas in "an unsightly bag atop of the machine", instead of in steel cylinders, as he suggests, was not due to innate stupidity on the part of the Briton, but to the fact that high-grade steel, such as is necessary for the safe storing of gases under pressure up to 2000 lb., which is common practice, was at that time in demand for far more important purposes.

I do not take such a pessimistic view of the automotive-fuel outlook as Mr. von Bernewitz appears to. At the present time there are more trained observers broadspread over the face of the earth searching for new oilfields than ever before in the world's history, and to me it will be astonishing if this systematic search does not meet with reward. Lacking the discovery of new important oilfields, however, it is generally accepted, I believe, that far more oil still remains absorbed in the porous rocks of abandoned fields than has been taken from them, and attention now is being turned to the discovery of a method by which at least a considerable portion of this oil may be obtained. Then there are the vast

deposits of oil-shale that have been proved to exist on this continent and that are estimated to contain far more oil than has been recovered from oilfields in America in the past. It will take time and money, of course, to develop these sources and to build plants for the extraction of the oil. The work that is being started to recover gasoline, heavy oil, and bitumen from the tar-sand of the Athabaska valley, in Alberta, will be watched with interest.

In the meantime, I fully agree with Mr. von Bernewitz that the use of oil for raising steam and of gasoline for stationary engines where other forms of fuel is available should be discouraged.

Last year was the first year in the history of the United States that the amount of coal coked in by-product ovens exceeded that coked in beehive ovens. As much as 46% of the coke produced is still made in beehive ovens. Each ton of coal carbonized is capable of yielding about two gallons of liquid that not only can be used by itself as an automotive fuel but that has the property of making alcohol miscible with gasoline and providing a fuel composed of three substances that may be used in existing types of engines. Straight alcohol, of course, requires a specially designed engine. It behooves the producers of coke, therefore, to see that the by-products evolved during the destructive distillation of coal are saved. The automotive-fuel situation admittedly calls for serious thought and active research, but not, I think, for anything approaching panic.

Victoria, B. C., August 19. F. H. Mason.

A Method of Blasting

The Editor:

Sir—On page 276 of your issue of August 21 you have a paragraph stating: "A method of blasting a heading, possessing a new feature, is reported from the Nordhausen mining district in Germany. Instead of two or three inclined shot-holes in the centre to un-key the face of the work, the holes are bored parallel with the axis of the drift, locally known as 'canon-shots'. These are arranged and fired to make a hole of no great diameter in the centre of the face by crushing the rock. Then a ring of shot-holes is bored around this central opening and fired. This removes a considerable mass of rock, thereby greatly enlarging the central opening. Another ring of holes, more widely spaced, clears the face. The novelty consists in the closely situated central crushing holes. Being so near together, it is not necessary to have a primer and fuse in each. The concussion of one shot is sufficient to fire the rest."

This is not a new method; it has been used in this country for a number of years, especially in raises, for which it is best adapted. The cut as used in this country is called the 'hunt' or 'barrel' cut. It consists in drilling three or four holes as near as possible together, in the centre and parallel to the axis of the raise. Instead of loading all the cut-holes, as in the German method, only one or two of the holes are loaded. The blasting of these holes breaks the walls of the others, leaving an opening of barrel shape, from which the cut receives its name. This is a good cut in raising, because the barrel frees itself of loose rock and allows considerable space for the other holes to break to.

In most mines the complete round is drilled, because, otherwise, the ground would be so shaken by drawing the cut-holes that in drilling the other holes afterward there would be considerable delay with fitchered holes.

The article states that "the novelty consists in the clearly situated central crushing holes. Being so near together it is not necessary to have a fuse or cap in each. The concussion of one shot is sufficient to fire the rest." In recent years, with the new light drills it is possible in most drifts and cross-cuts to swing the machine so that two or three cut-holes will meet, and while they all have primers and fuse, in most cases one primer and fuse would be sufficient to blast all of them.

Houghton, Michigan, August 24. S. S. Lang.

Enlarging Maps

The Editor:

Sir—I have had occasion to use, in the preparation of mine reports, a topographical map in cases where the cost of an actual survey is not justified. If the district is included in any of the published topographic surveys of the U. S. Geological Survey, an excellent substitute may be had by a photographic enlargement of the Geological Survey map. The latter is usually drawn to a very small scale and the location of workings, buildings, etc., cannot be accurately indicated on them.

Enlargements must be made accurately, preferably 5, 10, or 20 times, so that the scale may be preserved in simple ratios. Thus if the original scale is $\frac{1}{125,000}$, an enlargement of 10 diameters will increase the scale to $\frac{1}{12,500}$.

Portals, buildings, and other objects may be tied into some point shown on the Geological Survey map. If the enlargement is 20 diameters it will be necessary to make a tracing from the photograph, as the original lines have also been enlarged and become too wide and ungainly. Blue or black-line prints should then be made.

I have found maps prepared in this way to be very satisfactory and sufficiently accurate for ordinary requirements. It should be borne in mind, however, that if any inaccuracies exist in the original map, they will be proportionately increased. Too much dependence should not be placed on section-lines shown in these photographic maps. In some of the topographical maps, the notes of original section-line surveys appear to have been disregarded, and nothing but an actual survey, using the notes on file in the U. S. Land Office, will suffice. This is especially true in mountain areas, where the course of the section-lines appear to have been determined by the convenience of travel for the transit-man rather than by his instrument.

Samuel H. Dolbear.

San Francisco, August 10.

The Ore Deposits of Mexico—V

Ore Deposits in Igneous Rocks

By S. J. LEWIS

Introductory. Ore deposition results from chemical reactions. At bottom, the differences between those in limestone and those in igneous rocks reside in the fact that in the former the igneous structure, whatever its size or place, that we associate with the orebodies, is restricted; it serves as the conduit or passage from the buried magmatic mass to the limestone rocks; so that we can readily refer the ensuing precipitation of mineral to the action of the alkaline wall-rock on the sulphide solutions. In igneous rocks we are not dealing with a limited intrusion that serves merely to connect the limestone with the igneous reservoir, but with the reservoir itself: that is, with a more or less homogeneous mass of practically unlimited extent, out of which the magmatic solutions proceed, and in which the conditions of precipitation must usually be determined by other elements than the comparatively simple one of a contact with rock of different composition.

Mechanical forces, by fracturing the rocks, make openings that serve as Nature's receptacles for the circulating ground-water, in which reactions can take place as they do in any other container. Later similar forces introduce factors favorable to enrichment, like dikes or cross-faults, which frequently are of great importance in determining the distribution of ore; but aside from these ground movements, the whole process is chemical in its nature, strictly comparable to the work done in the laboratory, and differing from it principally in its enormous complexity and scale, and in the fact that we do not control it. In our experimental work we study the effect of a single reaction by excluding all others; in the work of ore deposition a multitude of reactions must go on together, with an intricacy of interchange that we cannot wholly grasp. Nevertheless, the only reasonable concept of the origin of orebodies in igneous rocks is based on the recognition of the whole process as being a series of chemical precipitations carried out on a vast scale in Nature's own receptacles.

A thick structure of volcanic rock presents special interest, because the mass may be regarded as of fairly uniform composition, possessing much heat which must be slowly dissipated, and exposed to surficial oxidation only after its surface has cooled and hardened. Fracturing in such a structure will in a general way occur in two periods: the first comes simultaneously with the crystallization of the rock-minerals, that is, it will be due to the contraction of the structure in volume; the second period will be marked by later fracturing across these cracks, caused by later intrusions or by regional movements, which will affect the mass more or less like forces exerted on rigid bodies. In such formations, therefore, we should find the channels of deposition irregular and branching, with sudden changes of dip and variations in strike, much like the cracks that occur in badly-annealed glass and having a similar origin; while the later fractures become local influences retarding or accelerating circulation and thus making for enrichment of the ore.

The two stages of mineralization in igneous rocks are therefore recognizable as the entrance, into the newly-formed fractures, of two different kinds of solutions: first, a direct filling with silica in various stages of gelatinization, carrying dissolved metallic minerals, all coming direct from the magma and usually hot; and, second, the entrance into the same channels of the thinner, colder solutions left after the excess silica has worked its way out. It will be obvious that differences in chemical equilibrium between these two classes of solutions will cause precipitation.

It is a matter of common knowledge that gold usually occurs in nature in quartz veins, either free from other metals except silver, or else closely associated with iron pyrite. It is also well known that silica, dissolved in acid, will under suitable conditions set to a jelly, just as ordinary gelatin does. If to such a preparation be added a solution of gold chloride, the latter will diffuse itself thoroughly within the solidified silica.[17] If now a watery solution of some precipitant be poured on top of the gelatin in the test-tube, two things will happen if conditions of molecular pressure are right, which throw a great light on the formation of such orebodies as we are discussing: first, the gold will be precipitated in crystals or aggregates, in the body of the jelly, and in larger bodies or crystals than are obtainable by other means; second, the precipitation will usually occur not all in one mass, but rather in aggregates scattered through the gelatine, and frequently in a series of bands of mineral separated by clear spaces. In the original Liesegang reaction, discovered in 1896, the bands of mineral were circular and concentric, alternating with light bands as in the later experimental work. The appearance produced is similar to that of a fine piece of red agate, which, it is believed, gets its banded appearance by the precipitation of iron in the way described.

The important factor in these reactions, and one bearing directly on the application of the principle to the formation of orebodies in nature, is the degree of molecular concentration of the mineral in silicious solution, com-

[17] Hatschek & Simon, 'Gels in Relation to Ore Deposition', Trans. I. M. M., XXI, 1912, p. 452.

pared with the degree of molecular concentration of the mineral in watery solution. The bringing together of two such media sets up circulation of the molecules from one medium to another: that is, osmotic pressure is induced in one direction or the other, depending on which is the more highly concentrated. If the concentration is greater in the watery solution, which is poured on top of the gelatine, the former will flow into the jelly and the gold will precipitate inside of the latter; if the concentration in the jelly is greater, then the pressure will be the other way and precipitation will occur in the water, at or close to the contact surface of the two media. The most important point is that the reactions can take place within the gelatine, notwithstanding the latter is either semi-solid or quite solid; and it has been shown that this is the case even if blotting-paper be used instead of gelatine, the reactions taking place just the same, only more slowly. It will be clear that the principle should hold true for minerals dissolved in solutions held in the solid igneous rock, given the difference in time, pressure, and temperature. I have seen a copper deposit in andesite in the State of Jalisco, near Colima, in which an area of several hundred square metres, and several metres thick, was well mineralized with flakes and crystals of pure metallic copper, which could hardly have been deposited in any way except from copper solutions moving through the solid rock and reacting with some other solution. The crystals of galena scattered through the limestone of the Mitra mountain, in Monterrey, above the dolomite horizon, may well have had a similar origin. In both cases, we must view the rock as a container of silicious copper or lead solutions, to which at a certain time a reducing solution of proper molecular strength found its way, just as it would into gelatine, and that in the same way it brought down the crystals or aggregates of mineral. In a similar way, the experiments with the solutions in test-tubes are paralleled by the filling up of fracture-cavities in igneous rock with gelatinous silica, which is subsequently acted on by reducing solutions. The delicate balance of molecular concentrations necessary for deposition to take place will evidently not often occur, making it clear why orebodies exist only here and there, and sometimes not at all, in otherwise fine-looking veins; the irregular shapes of the aggregates precipitated are paralleled by the irregular distribution of values in ore-shoots; and, finally, the alternation of bands of mineral with clear spaces in the test-tubes is paralleled by the occurrence of ore in lenses irregularly spaced one below the other in quartz veins, the lenses of mineral being separated by barren quartz. We thus reach the concept of a quartz vein carrying gold, silver, or other metals, as being a solid solution of silica in a rock-channel, with precipitated crystals or aggregates of the metals, held within the quartz just where they were precipitated.

A molten mass of igneous rock, existing under high pressure and temperature in an area of volcanic activity, before being expelled to the surface, must be a semi-fluid mass, in which the rock-minerals are carried in silicious and aqueous solution, and carrying also much excess silica and great quantities of magmatic water. These mineral solutions may be conceived to circulate freely in any direction throughout the mass, depending on molecular pressure. With the extrusion of the magma during an eruption, as in the pouring out of a lava sheet, the reduction in temperature and pressure would induce the immediate beginning of crystallization of the rock-minerals, simultaneously with a contraction of the mass and the formation of fractures or openings, the first of the three elements required for our reactions. The excess silica produced from the rock-crystallization could therefore find its way quickly into the openings, there to gelatinize gradually as it has been shown to do in certain mines, finally hardening to quartz. As this excess silica carries in solution many of the metallic minerals derived from the magma, we shall then have the fractures acting as receptacles for the gelatinous solutions of the metals, furnishing the second element we require. We would then lack only the addition of a watery precipitant to complete the requirements, and make possible the formation of orebodies.

Such a precipitant is furnished, if the conditions of pressure are right, by the magmatic waters resulting from the differentiation of the rock-minerals from the magma. Such thinner, later solutions of the metals, introducing a change of chemical conditions, can work into the gelatinized or solid silica in the vein-channels, with ensuing reactions. The precipitated metallic sulphides would then be found either as isolated perfect crystals in the solid quartz, or as aggregates or masses of crystals, sometimes of two or three metals, or grouped in horizontal banded structure or in concentric bands; or in lenses formed by combinations of all these forms, deposited in the quartz-vein in an irregular mass, with similar ones occurring under it and the bodies separated from each other by spaces of barren quartz. The existence in Mexican mines of types illustrating these reactions is familiar to all of us, especially in 'rosario' silver mines and in the concentric banding of many silver ores.

Alacran. These phenomena are beautifully illustrated in the well-known mine of this name in the Zacualpan district of the State of Mexico. Where the vein is narrow, between ore-shoots, banded structure is common. In the ore-shoots, concentric banding, in thin laminations parallel to the vein-walls, with the lines of deposition perpendicular to the latter, are common. Fig. 16*a* shows a piece taken from the bottom of the mine, 100 m. below the level of the Rio Alacran. The light bands are barren quartz, the dark ones are sulphides of silver and iron, with a trace of copper. The close resemblance to the concentric rings of the Liesegang experiment speaks for itself.

Five known chimneys occur in the mine, irregularly spaced over about 800 m. of strike, like beads on a string (Fig. 16*b*). This arrangement is usually assigned to cross-veins cutting across the lode; but I have never seen the cross-veins, and if they really exist they must

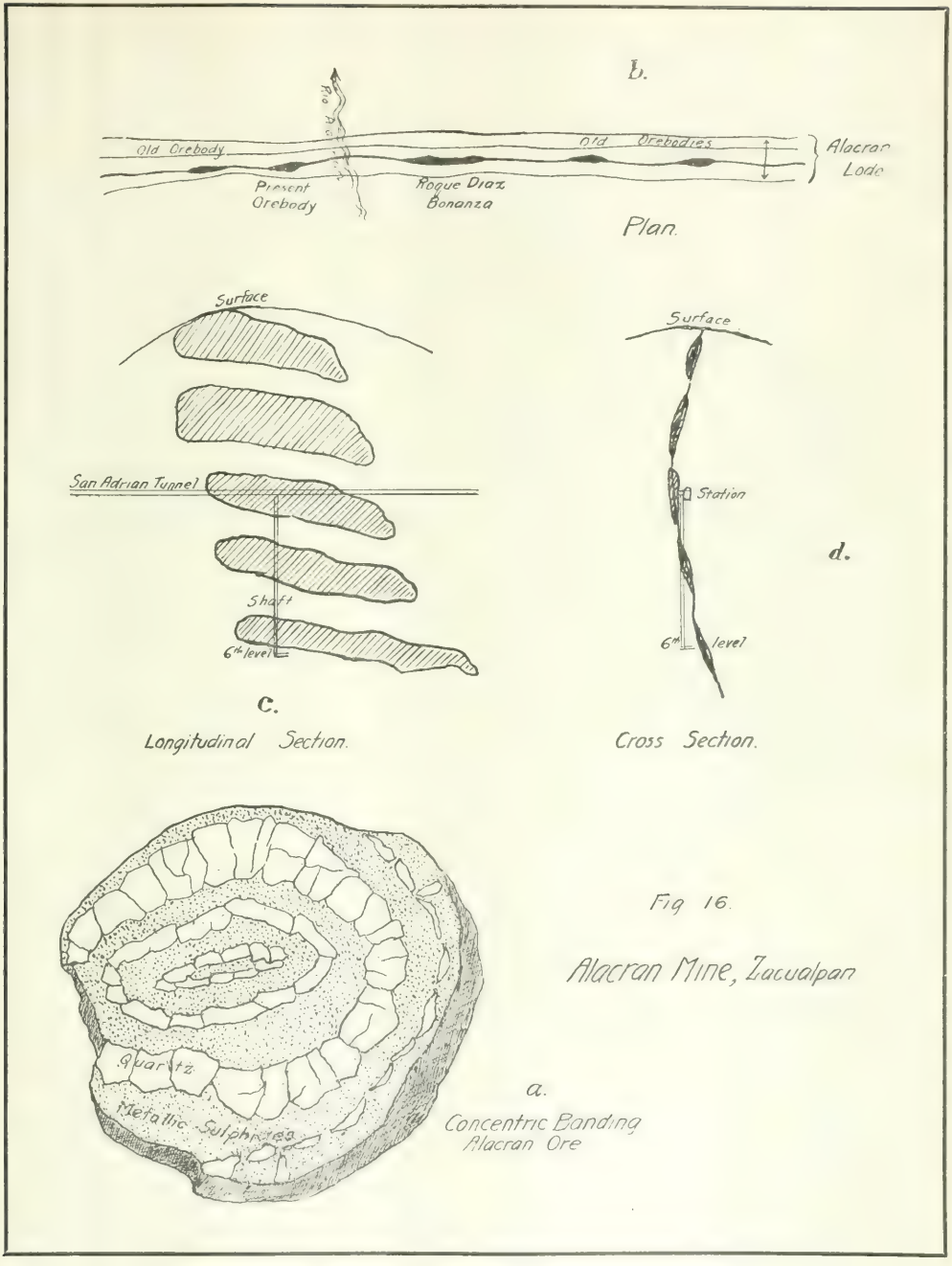


Fig 16.

Alacran Mine, Zacualpan

Fig. 16

be small and insignificant. The four parallel veins in the Alacran lode are well known and usually well defined. Only one of them carries the very rich ore that has given reputation to the mine. I believe that the importance of vein-intersections in this mine, and in general in the district, has been exaggerated. In the Alacran, they seem to have little, if anything, to do with the mineralization.

I have had the privilege of examining the latest of these bonanza orebodies,[18] which is at the bottom of the mine, and of studying the mine-plans. The remarkable alternation of lenses of silver-gold ore with spaces of barren quartz and wall-rock can at present be fully explained only as an example in nature of the silica-jelly reaction that we have been discussing. Throughout the whole ore-shoot, and it is said, in the old ones also, the ore occurs in nearly horizontal bodies 30 to 40 m. long, going down 20 to 25 m., and separated from each other by the same intervals of barren ground; one lens lies under the other, all having a slight pitch to the north and downward as in the sketch (Fig. 16*c*). Four such lenses have been worked in the present ore-shoot. In cross-section, the condition presented is like a string of short sausages (*d*). It has been stated locally that the alternate swelling and pinching of the orebody was due to the influence of layers of rock of different kinds, in the walls; but, as the formation is wholly in the Zacualpan andesite or greenstone, with totally insignificant inclusions of shale, such a hypothesis cannot be taken seriously.

Where the ore fails, the vein is usually only a few centimetres wide, and is at times hardly distinguishable, there being no walls and no openings. At enriched places, lenses of silver sulphides are found, 30 to 70 cm. wide, the ores carrying from 20 to 60 kg. silver per metric ton. The wall-rock for a short distance is also impregnated to the point of making good mill-ore. The unenriched spaces between the orebodies usually assay 400 to 500 gm. silver. All the high-grade ores carry gold, with a characteristic accompaniment of iron and copper sulphides.

There are many cases where such a series of lenses may be due to movement of the vein-walls on each other. Curved parts are thus brought together to form alternate swells or pinches. At Alacran there has been no discoverable movement of the walls; there is no gouge, no breccia, particularly no vein, the mineralization consisting merely of a streak of banded quartz, at times almost invisible. The vein is really a hardly distinguishable channel of mineralization, out of which silver minerals have diffused into the wall-rock and replaced it. The silver minerals in the silicious solutions filling this fracture must have been in a state of quite extraordinary concentration. Precipitated by some change of chemical condition, they came down in the silica of the channel and especially in the wall-rock adjacent to it, in a series of bands one below the other as in a gigantic beaker.

[18]Through the courtesy of Don Pedro Melendez, Director, Neg. Minera Alacran y Anexas.

On this theory we can easily understand the irregular and infrequent occurrence of ore-shoots in quartz veins. Cases where enrichment occurs at all swells and impoverishment at all pinches are comparatively simple; but they are in the minority. In most cases the pay-ore pinches out while the vein remains the same size; or the replacement of wall-rock to make ore occurs as a lens in unreplaced material.

Strictly speaking, we should regard secondary sulphide enrichment as a special case of the same process. We then have an existing orebody acting as a solid silicious solution of metallic sulphides, attacked by watery solutions of the same or other metals, the ensuing reactions causing precipitation in the solid quartz vein and consequent enrichment.

A rough classification will be useful to us in making even a brief study of igneous deposits in Mexico exemplifying these principles; the simplest may perhaps be based on the nature of the igneous mass in which the ore deposits occur. We may thus divide them into two classes:

1. In igneous masses intruding older formations.
2. In surface flows of varying composition.

The first class forms a link between the deposits in limestones, already studied, and those purely igneous masses; it will therefore be convenient to take it first. The second class is by far the largest and most important, for the flows are found in the great silver-producing mines of Mexico.

Class 1. In igneous masses intruding older formations.

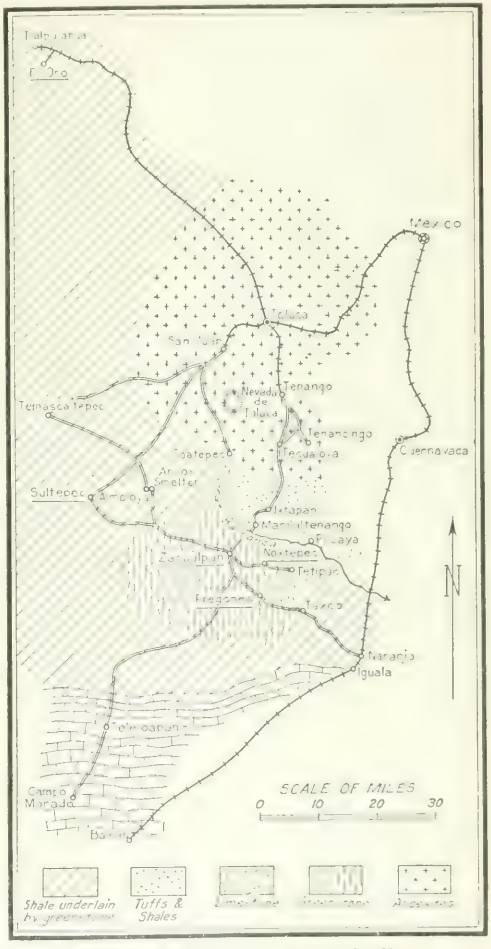
The Zacualpan District. Here, in the southern part of the State of Mexico and close to the Guerrero line, are excellent illustrations of this class. The mines were alluded to above in discussing the Sultepec continuation of the El Oro shales.

The ore deposits of Zacualpan are in a green andesite like that of El Oro. In thin sections the rock is seen to be profusely pitted with amygdules, in which the processes of oxidation have deposited beautiful crystals of secondary hydro-silicates. The ferro-magnesian mineral is generally hornblende and is not abundant. The rock is fresh, generally speaking, but shows much strain in the vicinity of the veins, and flow-lines can frequently be distinguished. Secondary quartz and calcite are plentiful in the minute veinlets of the rock. A schistose appearance has been induced in the neighborhood of veins owing to the heavy pressure to which the mass has been subjected.

This andesite is the only eruptive rock in the district and is the principal member of the formation. Black and gray shale, similar to that of El Oro, occurs in scattered bodies as the subordinate member. This shale, coming down from Queretaro and Guanajuato to El Oro, thence to Sultepec and into Guerrero, has been pierced by one or more laccoliths of the andesite, presumably in Miocene time, from a centre at or near the Toluca volcano (see map). The igneous masses, working their way between the strata, pushed them up and tore them away

until the intrusion was solidified. The domed part of the shale was also the thinnest, and with the breaking due to the uplift became easily degraded by atmospheric agencies. This wearing away has exposed the andesite throughout the district, with the shale on its flanks and with small inclusions scattered all through it, some visible on the highest hills of the district. A cross-cut of the country from Sultepec to Zacualpan* (Fig. 13) shows the shale in place at Sultepec, though much disturbed in dip and composition, and the greenstone underlying it in the form of a sill, much as at El Oro. Between the two towns are a few small isolated masses of limestone of the late Cretaceous. Continuing south toward Zacualpan, the greenstone mass rises higher and the shale thins out, until we come to the Zacualpan district proper, where the greenstone forms the whole surface, the shale appearing only as scattering inclusions, or 'islands', varying in size from a few cubic metres to many thousands. These evidently were torn loose from their original bedding by the swelling intrusion, floated on the molten mass, and solidified where chance found them when cooling began.

Vein formation, resulting from cooling and settling of the laccolith, has been extremely complex in this district. The fractures have followed the general laws we have discussed; but instead of cracking through a homogeneous mass, the movements have encountered the shale inclusions alluded to, and have gone right through them; and the deflection of path, modification of channel, or change in character of vein-filling, have all been matters of vital importance to the miner. Adapting themselves to the difference in brittleness of the two rocks, the fractures have been strong and well defined as long as they continued in the andesite; but wherever they have encountered shale, the strata have yielded to the movement, partly returning to their old position, and the channel has consequently been made much smaller. For the same reason, such places show temporary changes of dip in the vein. The mineralization therefore is nearly everywhere narrower in the shale than in the andesite, besides being usually of a different character. The general rule of the district has been that as long as the vein stayed in andesite good ore could be expected, but that if shale was encountered in the course of stoping on good ore, the assay-value would drop immediately and coarse zinc and lead, with but little silver, would be dominant in the mineralization. A good illustration of this condition was noted a few years ago in the Cuchara mine close to the town, one of the minor properties of the district. It had yielded small orebodies from Spanish times and had been worked down to the level of the Alacran river, which drains this part of the country. At this level the mine was apparently bottomed; a drainage-adit driven 600 metres from the surface to cut all the veins, with about 200 metres of exploration on them, showed no ore of value. The mine was practically abandoned. Careful study of the ground showed a horizontal inclusion of shale, about four metres thick, outcropping in the arroyo at the level of the adit, with the solid andesite beneath it stretching away for several kilometres down the arroyo. Investigation showed that the long and vitally important adit had been driven for its whole length in this accidental shale formation, varying in thickness from the four metres seen at the surface to about 18 m. at the thickest known point in the mine. High-grade ore, which had been followed down to this



GEOLOGIC MAP OF ZACUALPAN DISTRICT

level in a satisfactory width, pinched to a few centimetres of black-jack and coarse galena, the usually persistent antimonial silver disappearing entirely. Twelve metres of exploration downward had failed to show improvement; evidently it was necessary to pass through the shale and get into the andesite again. The winze therefore was cleaned out and deepened, the shale left behind, and with a total of 20 metres of new sinking, the upper edge of a new orebody was cut, carrying rich silver minerals, which persisted down to about 80 m. below the level of the arroyo.

*See 'M. & S. P.' of June 26, page 935.

A similar occurrence was noted in Chontalpan on the fourth level north several years ago. Excellent ore dropped to 200 grammes per ton when the drift entered the shale, and returned to a kilogramme when the shale was passed. On the other hand, the most valuable orebody found in the Chontalpan mine in modern times occurred below the fourth level at a point where there is a great deal of shale in the foot-wall.

The Zacualpan ores are silicious, with considerable calcite in the gangue of some of the veins. The silver appears both as proustite and pyrargyrite, but principally as antimonial ruby silver. At Chontalpan the ruby usually occurred massive, smeared over the surface of the ore, especially in conjunction with fine-grained lead. At other mines near-by, the Carmelita for example, the ruby occurs in fine crystals and needles, quite transparent and standing on end within small cavities. Argentite is common and is disseminated through the ore. Good crystals are found occasionally, both free in cavities and embedded in the gangue. Some fine stephanite crystals have been found also, especially at Chontalpan. Native silver occurs commonly in the form of wire and flakes, usually the former, in small cavities in the high-grade ores.

Gold is not an important mineral in this district. In the strictly-silver mines, like Chontalpan and all those close to the town, the gold rarely exceeds a gramme per 'kilo' of silver. In the mines verging toward the western edge of the district, like Alacran and Carboncillo, a high gold content is noted, usually from an ounce to two or three per ton.

Zinc occurs in two forms. The coarse-grained blackjack, generally associated with coarse galena, seems to be the primary mineral. The light-brown zinc *acopalado* that is invariably associated with silver minerals, seems to be of later occurrence. It is found in some of the mines in fine branching leaf-like or tree-like crystals, grown into the calcitic gangue, outward from secondary fractures in the vein-filling. In other mines it occurs as fairly large crystals scattered through the rock. Lead occurs in the same way: coarse large galena crystals with little or no silver; and fine-grained, steely lead, the *acerado* of the miner, with pronounced silver enrichment. Wherever pyrite is found in coarse crystals it also is barren of silver; in most of the mines of the district the iron sulphide shows poor silver mineralization at best. There is, however, a class of pyrite, fine-grained and frequently associated with a little copper, that is rich in silver. Marcasite occurs sparingly, associated with silver minerals, in beautiful thin plates in cavities.

The veins usually have a well-defined hanging-wall stringer and frequently a similar stringer on the foot-wall, with the rock between unreplaced, or shattered and partly replaced by stringers of ore, or completely replaced by sulphides of lead, zinc, and iron, with silver. The average width of the veins is from 30 cm. to a little less than a metre. Calcite occurs usually as spar; quartz as massive silica with occasional fine crystals in open spaces. A fibrous amphibole occurred in the Cuchara mine in depth, associated with the pay-ore, loose in cavities. Silver-bearing ores of bismuth and antimony also occur in small quantities.

Although the veins are narrow, the ore is so rich in silver at points of enrichment that mining is profitable; and the strong walls, without dangerous gouge or much water, make the camp attractive for operators with little capital. Few of the mines have had the advantage of modern metallurgical methods or equipment, and there has been little systematic development.

The controlling factor in the deposition of ore in this district is commonly supposed to be the intersection of veins or their coming together in some way. As I look back over many years of experience in this and other districts, it is surprising to see how few mines there are where the orebodies were found at the intersections of the veins, and it may be worth while to go over a number of examples to see what truth there is in this popular generalization.

In the Cuchara mine, the fracture system consists of two principal veins: the high-grade vein, running north and south, and the low-grade lead vein, running east and west (Fig. 17). The second is a later vein that cuts off the principal vein in the southern part of the workings, displacing the faulted ground so far as to take it out of the property. The northern part of the ground, about 120 m. away, is also cut off by a late vein parallel with the lead vein. The two fault-veins dip toward each other, so that the short undisturbed block between the two fault-planes, like an inverted pyramid, is the productive formation, by which is limited the life of the mine. If it were true that orebodies occur at the intersections, we should get an orebody at each end of the undisturbed block; as a matter of fact, the valuable ore has always been found at some little distance from the area of disturbance.

In this example the angles of vein intersections are high, from 45° to 75°. Our next example is one showing acute angles, from 15° to 25°, in the Carboncillo mine at the southern edge of the district. The important orebody taken out here in recent years has been mentioned already; it occurred on one of the four veins of the fracture system, not immediately at the intersection, but at 30 or 40 m. from the junction of the veins. The rich mass was about 30 m. long by 25 m. high. Mineralization at the intersection itself was meagre.

In the old San Miguel Tlaxpampa mine, at the edge of Zacualpan, four veins come together at an acute angle. Generally speaking, the orebodies have not formed at the intersection, but rather at short distances therefrom. Where the veins diverge like a fan toward the north, it is interesting to note the parallelism of ore occurrence on all of them (Fig. 19). The lenses of silver ore are found at 30 to 100 m. north of the general intersection, on all of the veins so far as known.

In the Chontalpan mine, at the extreme southern edge of the district, the most remarkable intersection comes at the extreme south end of the principal level. Here three veins come together to form the main vein; the three branches have been followed south for long distances

without showing any ore of great value. The intersection itself shows nothing at all in the way of ore; real mineralization begins at about 30 m. north of the junction and goes on without apparent relation to the intersection. See Fig. 20.

These are all cases where mineralization is known to persist as pay-ore. The case of Alacran has been cited already. In other cases, like the Bella Vista on the Acebedotla river, there is a fine intersection of two veins, but no ore; the little surface pockets formed near the intersection having been dug out long ago. In still other cases, like the veins of the Alacran or the neighboring Reforma vein, we have recurrent lenses of mineral with nothing in the way of an intersection immediately near them. On the other hand, a case occurs in the San Miguel Tlaxpampa mine that shows the reverse condition (see Fig. 18). A cross-vein of great importance on the principal level intersects the lodes at their greatest known points of mineralization, indicating by its filling and other conditions that the intersection was largely responsible for the orebody.

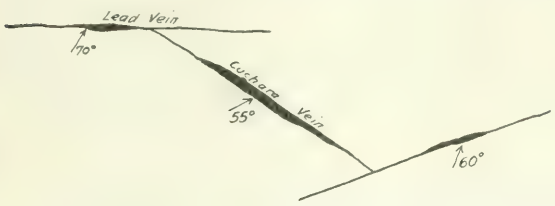


FIG. 17. SYSTEM OF VEINS IN THE CUCHARA MINE

From these examples and many others that might be adduced, we see that orebodies in this district do not occur always at or immediately close to the intersections of veins. The better way to look at such intersections would be as Nature's method of bringing in the watery solutions that effect the precipitation of ore in the older veins. In all the cases cited, the fractures are of varying age and the filling of the different veins is strikingly individual, so that in the same mine one can always tell from which vein a given piece of ore came. Usually the oldest vein is highly silicious and the ground has been re-opened by the later fracturing, which allows the new solutions to enter and find their way into the silicious solution in which precipitation is to take place. The intersections, therefore, in the last analysis are merely the evidence of later fracturing, or the channels by means of which the later precipitants have been brought into the reaction. They are of the highest importance; but they do not necessarily signify ore deposition, and the idea that ore generally occurs at such intersections is not well supported by the facts. Numerous intersections simply mean that the ground has been well loosened, probably at two or more different periods, and they are therefore a favorable sign, but nothing more.

The deepest mining below natural drainage-levels in the district was probably done in the famous Dios Nos Guie mine, in which the ore is said to be highly oxidized to a depth of much over 100 m. below water-level, with considerable water in a rather wide vein. The mine has been in litigation for thirty years, but has just been re-opened and will be available for study. The water in the bottom level is warmer than the body temperature. The Chontalpan mine is the next deepest, and is probably the most extensively developed at the present time, of the mines in this district. The adit-level is 160 m. below the outcrop, and the inclined shaft on the vein, by which development has been done in depth, is over 200 m. deep from the adit down to the seventh level. The mine may be taken as the type of the district, for purposes of study, with a total depth of 360 metres.

The Chontalpan vein system is complex, and the features common to Tertiary ore deposits formed at moderate and shallow depths are well illustrated. An especially striking feature is the tendency of the numerous veins to unite in depth, with abrupt changes of dip.

The Chontalpan vein system has so many branches that it is convenient to regard them as three different sets of fractures separated by short time-intervals. They all have an easterly dip, varying from 50° to 60°; the narrow hanging-wall veins constitute the first group; the somewhat wider foot-wall stringers make the second group; and the strongest fracture, passing through both the other groups and making an approximately straight

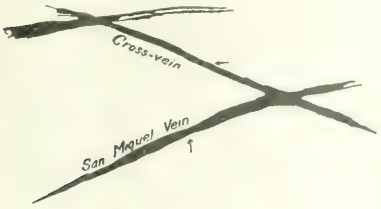


FIG. 18

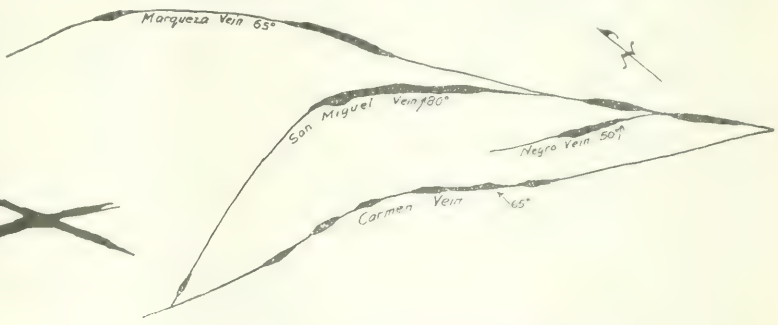


FIG. 19. JUNCTION OF VEINS IN THE SAN MIGUEL TLAXPAMPA MINE

channel, constitutes the principal vein of the deposit. It will be evident from the sketch (Fig. 20), that the smaller veins are really mere branches or offshoots from the principal fracture. The resulting channel is very irregular and the distribution of ore-shoots is equally so. The ore is seldom found at, or immediately close to, the intersections; rather it begins a little away from them, as though deposition sought to take place in spots removed from disturbance. Very interesting examples of this are found in the hanging-wall veins, which at their coming together with the main channel are only a few fingers wide. On following them they widen out to valuable deposits, until one again approaches the main channel, when the ore again becomes narrower and finally pinches at the intersection. The best hanging-wall body found in recent years was discovered by exploration based on pitch of the ore-shoot and running but a short distance on the level. When we study this chimney, we find that it began practically on the surface, where Jean de la Borde took out the first lenses two centuries ago. It has been followed down ever since on its southerly pitch, the lenses of ore re-appearing and closing with depth, till our own time, when good ore was taken out of it on the second level and followed down with local contractions as far as the seventh, the present deep level of the mine. A sketch of all these orebodies would show a series of contractions and widenings, just like the Alacran ore-lenses diagrammed in Fig. 16. Between the fifth and sixth levels there is the largest barren space known between lenses: the lens on the sixth was good, but short; and that on the seventh seems to be considerably longer. The extremely rich ore of the middle levels is not found in such

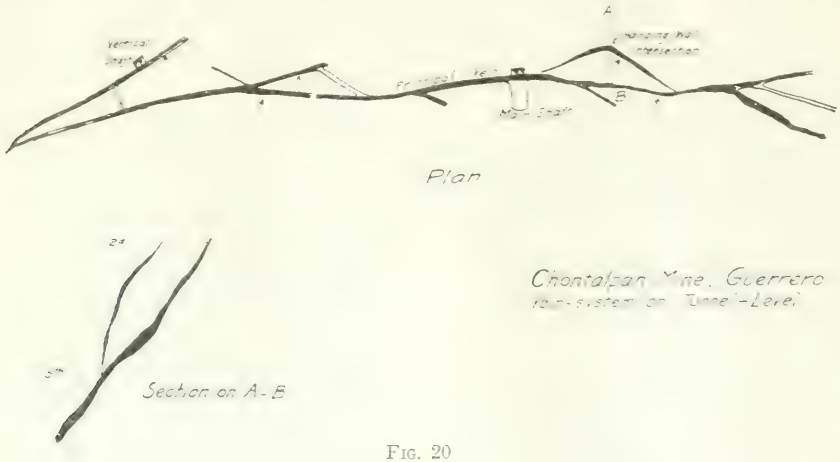


FIG. 20

this reasoning, a cross-cut being driven on the second level to cut the widest part of the supposed lens, which was treated as an intersection of two hanging-wall stringers going in opposite directions. A fine orebody was found carrying exceptionally clean and rich ore, which diminished gradually in size and value in both directions back to the principal vein. Similar work was then done on the lower levels, and the continuation of the same and similar bodies found by this means. In the case of foot-wall veins, driving on them southward from the main fracture has generally showed good mineralization as soon as the miner got away from the intersections.

The most important orebody found in this mine in recent years occurred a little below the fourth level, where a foot-wall vein with a flat dip came together with the principal vein. The extreme foot-wall showed a great deal of shale, and the effect of it was evident in the large amount of zinc and lead in the ore; but silver minerals were so abundant as to make the deposit very valuable. The impregnation of the wall-rock between the two veins made pay-ore at one point, five metres wide. When it is remembered that in these veins 70 cm. is an excellent stoping-width, the result can be appreciated. The deposit, of course, was a chimney, going down with the abundance in the bottom, but there is really no essential difference in the mineralization. I should say that we have here the same phenomenon as at Alacran, that is, the precipitation of silver mineral in a series of lenses under each other, following a definite pitch dependent on circulation currents, and separated from each other by barren vein-filling.

The same habit of enrichment is noted at other mines in the district, the chimney occurrence being so marked as to have given rise to the term *rosario*, that is, rosary, to describe the formation, like a string of beads; the lenses of ore being the beads, strung out one below the other on the thread of mineralization. The secret of getting ore therefore is to sink on known chimneys, passing through the patches of barren vein-matter that occur between orebodies.

The veins of the district have a marked tendency to come together in depth, this being especially the case at Chontalpan. In depth therefore the ground will have a tendency to be less fractured, and as much of the enrichment is distinctly from late solutions, the question of persistence resolves itself into a study of the degree of fracturing that may be expected in depth in a given deposit. In general, deposition of minerals seems to have

begun on the vein-walls, beginning with galena and zinc, the former coming first, followed by distinct banding of the sphalerite. Ribbon structure is common; mineralization worked its way toward the centre of the fractures, which are quite commonly still open channels. Scalenoids of calcite and fine long quartz crystals sometimes occur in these open spaces, with excellent crystals of ruby silver, argentite, and stephanite, the last rarely. The ruby often comes in scales, stains, and crystals, in minute fractures in the calcite or on the surface of calcite crystals. It is quite evident that the making of pay-ore in these veins is largely a matter of secondary enrichment through the carrying down of silver minerals into the chimneys, that is, it is dependent on the thoroughness of the secondary fracturing. The Alacran shows rich ore at a total depth below outcrop at present not exceeding 250 metres; Chontalpan shows good ore at 340 m.; San Miguel Tlaxpampa, at 240 m. The best information available on Dios Nos Guia would indicate the critical depth as about 300 m. I should say that enrichment to pay-ore in this district should extend to a total depth below outcrop of about 450 metres. Thus the deposits are typically Tertiary.

Similar deposits, with the chimney feature more or less in evidence, occur at Noxtepec, Pregones, and Taxco. The deposits of Noxtepec are narrow, but very rich, veins, usually carrying gold, and the small orebodies go down, one below the other, strikingly in the rosary form. The best-known example is the Xitinga. About half-way between Zacualpan and Taxco are the Pregones mines, of which the old Negrillas is the most important. Here the veins are sometimes very wide, that of Negrillas being between 4 and 8 metres of brecciated quartz, with the better enrichment on the foot-wall. The condition is complicated by the presence of a black, heavy, basic andesite on the foot-wall of the deposit, giving rise to contact phenomena. An interesting feature is the cinnabar vein that is part of the Negrillas lode.

Production of Copper in the United States, 1913 to 1919

In the following table the production is apportioned to the States in which the copper was mined. The figures represent the content of fine copper in the blister produced and the smelter output of ingot and anode-copper from Michigan.

	1913	1914	1915	1916	1917	1918	1919
Alaska	*[illegible]	24,985,847	70,695,286	113,823,064	81,759,086	67,081,648	56,534,992
Arizona	401,258,850	382,449,922	432,467,690	694,847,307	719,035,514	769,521,729	536,515,368
California	[illegible]	29,784,173	37,658,444	43,400,876	44,933,846	44,150,761	23,548,698
Colorado	[illegible]	7,316,066	7,272,178	9,536,193	10,054,951	7,591,570	4,892,558
Idaho	8,711,400	5,875,205	6,217,728	7,248,794	6,446,224	5,836,795	3,966,655
Michigan	[illegible]	158,009,748	238,956,410	269,794,531	268,508,091	231,096,158	201,716,335
Montana	285,724,467	236,805,845	268,263,040	352,139,768	276,225,977	326,426,761	176,289,873
Nevada	[illegible]	60,122,904	67,757,322	100,816,724	115,028,161	106,266,603	64,683,734
New Mexico	50,196,881	64,204,703	62,817,234	79,863,439	107,593,615	96,559,580	60,377,320
Oregon	[illegible]	5,599	797,471	2,433,567	1,105,097	2,630,499	2,808,017
Tennessee	[illegible]	18,661,112	18,205,308	14,556,278	16,093,757	15,053,568	15,629,454
Utah	148,057,450	160,589,660	175,177,695	232,335,950	227,840,447	230,964,908	146,178,088
Washington	[illegible]	683,602	903,661	2,473,481	2,051,416	2,330,568	[illegible]
Undistributed, miscellaneous	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14,110,117
Total	1,224,484,098	1,150,137,192	1,388,009,527	1,927,850,548	1,886,120,721	1,908,533,595	1,310,972,580

*Figures are in pounds

Lead Production

Ordinarily the United States produces about 50% of the world's supply of lead, but this production is insufficient at the present time to meet the demands for home consumption. During the past year lead has been imported from England, Australia, and Spain, and some lead which was exported to England was re-imported. Lead which in normal times was produced in Mexico, and passed through the United States in bond for exportation to European countries, has recently been held here to satisfy our own demands. The supply of lead in this country, and the changes in lead stocks for the first half of 1920, as compared with the same period of last year, are interestingly set forth in the following figures from the Metal Bulletin:

	1919, tons	1920, tons
Government stocks, January 1	62,892	54,978
Imports, January to June	152,248	62,433
Available supply	215,140	117,408
Exports, January to June	6,579	29,725
Left for home consumption	198,531	88,684

The three most important uses for lead are in the manufacture of white lead for the paint industry, which requires over 175,000 tons annually; in the manufacture of storage-batteries, which absorbs over 150,000 tons of lead annually, and has increased between 50% and 100% per annum during the last three or four years; and in the manufacture of cables and conduits. The battery trade has been increasing rapidly in importance, due to wider application of storage-batteries for starting and lighting purposes on automobiles, for mine-locomotives, for the operation of small motors in industrial plants, and for farm lighting-plants. Building operations have been falling below normal requirements all over the country, and are now forcing a big demand for paint and plumbing supplies, which helps to swell the total demand for lead to a tonnage which exceeds production. In view of the increasing demand for lead and lead products, the absence of any reserve supply of the metal, and the inability of lead producers to materially augment their production, lead is in a very strong statistical position, and is likely to remain so for some time to come, in spite of the fact that the present price of the metal is much higher than obtained over a long period of time prior to the War.

THE volume of the salt in the ocean, according to the U. S. Geological Survey, is enough to cover the entire surface of the United States to a depth of 8500 feet.

Roasting and Chloridizing of Bolivian Silver-Tin Ores

By M. G. F. SOHNLEIN

*In the metallurgical treatment of sulphide silver-tin ores mined at Oruro, Potosí, and Chocaya, the most important and difficult step is chloridizing-roasting. The ores are mined chiefly from veins in rhyolite, a detailed description of which can be found in most textbooks on ore deposits. The chief gangue minerals are pyrite and quartz, and the silver content is derived from tetrahedrite, jamesonite, stibnite, and cylindrite. Most of the tin is present in the form of a rather impure cassiterite, which forms microcrystalline aggregates of varying richness with quartz and pyrite; occasionally some tin is found as stannite, cylindrite, and other complex sulphantimonates. The silver content of the minerals that compose the ore is approximately as follows: pyrite, 3 to 5 oz. per ton; jamesonite, 30 to 50 oz.; stibnite, 30 to 150 oz.; cylindrite, 200 to 300 oz.; tetrahedrite, 500 to 3000 oz. Occasionally some ruby-silver ore is found, but it is rare. In the mines of Oruro, which are the deepest in the sulphide zone, tetrahedrite has nearly disappeared, stibnite, jamesonite, and, in the deepest levels, cylindrite taking its place.

At present there are six mills treating this ore, two at Potosí, two at Chocaya, one at Poopo, and one at Machacamarca. The ore is crushed dry, given a chloridizing roast, leached with water and hyposulphite solution (or with brine) to extract gold, silver, and copper, and concentrated for tin with or without re-grinding.

Between 1890 an 1900, amalgamation was replaced by leaching with either hyposulphite solution or brine. It is remarkable that tailings from high-grade ore treated by amalgamation and those derived from ores of much lower grade that have been leached contain about the same amount of silver, namely, from 5 to 7 oz. per ton. The percentage of chloridizing that can be obtained is not directly proportional to the silver content of the ore, but it seems as if the quantity of silver that cannot be converted into chloride is more or less constant. For instance, after roasting on ore containing 25 oz. per ton, the amount of silver that cannot be chloridized will be 5 to 6 oz. per ton; whereas, with ore of 100 oz. per ton, after roasting, there will be from 8 to 9 oz. of insoluble silver. The silver that has not been chloridized and is left in the tailing after amalgamation or leaching cannot be dissolved by cyanide or any other commercial solvent known to me. Only a small proportion of it is contained in sulphides that have remained undecomposed owing to imperfect roasting; if these tailings, after fine grinding, are treated by flotation, a small amount of concentrate having about the same silver content as the original ore can be obtained, but the amount extracted is insufficient to pay for this treatment.

*Abstract from a paper presented at the Lake Superior [illegible]

On account of the difficulty, expense, and silver loss connected with chloridizing-roasting, more direct treatments have been tried for these ores. Agitating the raw ore with cyanide or bromine cyanide after fine grinding is absolutely ineffective; neither can commercial results be obtained by attempting to decompose the sulphantimonates with metallic aluminum, followed by cyanide treatment. This experimenting was carried out chiefly by one of the best known ore-testing laboratories in the United States. Cyanide consumption on either raw or roasted ore was excessive, and the extraction obtained by agitating the finely-ground roasted and chloridized ore with cyanide was not better than by leaching the same material at 16-mesh with hyposulphite. Therefore, thus far the old method has proved to be the only way of treating these ores; and to increase the mill capacity and decrease the cost, it was necessary to find a mechanical furnace that would perform roasting and chloridizing as well, or better, than the old hand-rabbled reverberatory furnaces.

Chloridizing is simple and quick if salt is added at the correct stage of the roast. If salt is mixed with the ore before nearly all the sulphur has been converted into sulphates, it will retard roasting and increase volatilization losses; besides, salt is consumed unnecessarily. If the salt is added too late, it will fail to react properly and too low a proportion of silver will be converted into chloride. In hand-rabbled furnaces, the correct amount of salt is 3.5% for an ore of 25 oz. per ton and 5% for 50-oz. ore. An excess of salt has no particularly harmful effect on the process, but the excess is left undecomposed in the roasted ore, and during the water-wash that precedes hyposulphite leaching, it forms brine which dissolves silver chloride.

Usually the hand-rabbled reverberatory furnace has one continuous hearth, 10 ft. wide, divided into three sections 10 ft. long. There is a drop of 4 in. from one section to the other, the highest being next to the flue, where the raw ore is charged through a drop hole in the arch. A charge of 700 kg. is brought into the furnace and rabbled until it ignites. During normal operation there is a charge in each section of the hearth and care is taken that no ore is rabbled into the section lower down than it belongs. If the charge on the third section is so far roasted that it shows but a few sparks when rabbling, the salt is shoveled into the furnace. The decrepitation of the salt causes violent dusting; therefore, the draft of the furnace is shut off until decrepitation ceases. After the damper is again opened, the charge is rabbled until chloridizing is completed, when the ore will not flow, but packs together somewhat like snow and stands up with nearly vertical sides. The chloridizing takes a little less than one hour in these furnaces; once the ore begins to

pack, it is useless to continue rabbling, because the amount of chloridizing is not increased. If worked by two men, one furnace has a capacity of 4 to 4.5 metric tons per 24 hours. A little taquia fuel is used during chloridizing, because it is not possible to rabble the charge during chloridizing as continuously as during oxidizing, on account of the corrosive fumes that escape through the working-doors, for, to keep down the volatilization losses, the furnace is worked with reduced draft.

A charge remains about 4 hours in each section and is in the furnace altogether 12 hours, of which less than 1 hour is used for chloridizing. It would therefore be a mistake to try to chloridize continuously, adding salt to the last hearth or section of some kind of mechanical furnace, because the atmosphere in the furnace would be charged with chlorine, which retards roasting and attacks the metal parts. Moreover, continuous work has the disadvantage that, if ore with insufficient sulphur enters the chloridizing section poor work will be done until conditions are improved, which will take considerable time with a roasting furnace of some size.

Satisfactory metallurgical results are obtained from hand-rabbled furnaces worked by competent men; formerly, these could be found, as chloridizing roasting was practised in Bolivia for generations. The average silver loss caused by dusting and volatilization during a period of several years was calculated to be 6 to 7% at Machacamarca; if the furnace is worked carefully, the loss can be reduced to a lower figure. The cost of roasting was not high, being around $2 per metric ton, including everything, but as the plants grew in size and tin mining drew a large proportion of the men from the silver mines, it became imperative to use mechanical furnaces.

The first mechanical furnace installed at the Machacamarca plant of the Compañía Minera de Oruro was a six-hearth McDougall with an inside diameter of 14½ ft. It was first used in connection with two hand-rabbled chloridizing furnaces, where the calcines were mixed with salt. The furnace was fed with ordinary run-of-mine ore which contained about 35 oz. of silver per ton and 30% sulphur; the product from the McDougall contained from 4 to 4.5% sulphur. It was soon evident that the silver losses in the McDougall furnace were much higher than in the reverberatory furnaces. The loss of weight during roasting is from 18 to 20% on an ore with about 30% sulphur; therefore, if the raw ore assays 35 oz. per ton, the roasted ore should contain approximately 42 oz. per ton if no silver were lost during roasting. Instead of this, the product from the McDougall furnace assayed, usually, a little less than the raw ore, which proved that at least 20% of the silver passed through the stack. Later tests proved this loss to be much higher. The capacity of the furnace was 20 metric tons per 24 hours when roasting from 30% sulphur to about 4%. Water-cooling was used, because on a 30% sulphur charge the furnace would run so hot that if no particular care was taken, the ore would sinter on the third hearth, causing frequent breakage of rabble teeth. The higher the temperature, the heavier were the silver losses through volatilization. The economy in labor was not as great as had been expected, because one attendant was needed for the McDougall and four furnace-men were required at the reverberatories for chloridizing. These men could have roasted and chloridized 9 tons per day, using the reverberatories without the McDougall, so that the cost of labor was only reduced to about 45%.

It was therefore evident that the furnace should be used in some other way. For some time the attempt was made to assist chloridizing by feeding salt continuously into the furnace on the fifth hearth. The rabbles were so set that on this hearth the ore was moved from the periphery to the centre, so that, if salt was fed through one of the working-doors on the fifth hearth, chloridizing took place on the entire surface of the fifth and sixth hearths. But at this point the ore was not sufficiently roasted to react well with the salt, and the final product from the furnace contained too much sulphur and unchloridized silver to allow dispensing with the reverberatories to finish the work. Later, in order to reduce the heavy losses of silver, the furnace was used only for roasting ore containing from 12 to 15 oz. of silver per ton with about 25% sulphur, but even on this material the silver losses were entirely too high.

The charge for the McDougall furnace is now prepared by mixing low-grade fines of run-of-mine ore with high sulphur content with silver-tin ore which carries only 15 to 20% sulphur. When working on this ore the furnace has a maximum capacity of 22 metric tons per 24 hours and delivers its product to one reverberatory furnace for finishing and chloridizing instead of to two furnaces as was the former practice. On ore with more than 30% sulphur, the capacity is only 17 tons. No fuel is used in the McDougall, but a small amount must be supplied to the reverberatory furnace so as to keep its temperature high enough for continuous chloridizing. The difficulty common to all continuous chloridizing is experienced here—slight variations in the McDougall furnace caused by different compositions of the ore, etc., are at once reflected in the results. An attempt to remedy this was made by placing a small bin between the McDougall and the reverberatory, where the partly roasted ore could be stored, if it came down with too much sulphur. With this arrangement, two men working at the reverberatory furnace could finish roasting to the desired point without having to add the salt, and if the ore came down with too much sulphur, the charge to the furnace could be at once reduced. But it takes several hours to bring the McDougall furnace back to proper conditions, and if too much half-roasted ore was held in the bin, it became too cold for chloridizing, so that this arrangement was not satisfactory. Often some of the ore had to be chloridized before it was properly roasted to prevent its becoming so cold that it would spoil the work of the reverberatory roaster altogether. If, on the other hand, the ore came down too much oxidized, chloridizing would be bad because the salt could not react properly with the ore. There was no remedy for this, except mixing with elemental sulphur before chloridizing, which procedure is far too complicated and too expensive for practical work.

Losses of silver through dusting and volatilizing can be prevented by passing the roaster gases through a Cottrell precipitator. Experiments made by a representative of the International Precipitation Co. showed that 9500 cu. ft. of gas containing 0.32 gm. of solids passed each minute out of the stack of the McDougall furnace. Therefore, 4300 kg. of dust was carried away per 24 hours. At that time the feed to the furnace was 22,400 kg. per 24 hours of ore carrying 670 gm. silver per ton. The sample collected in the filter assayed 1070 gm. per ton; therefore, a little over 30% of all the silver that goes to the furnace is lost through the stack. The flue-dust is a mixture of totally oxidized, half-oxidized, and raw ore, and contains considerable antimony trioxide. The erection of a Cottrell treater alone would not have solved the problem, for the chief difficulty was the disposal of the dust. (1) It might be returned to the furnace feed; (2) it might be fed, together with raw ore, to one or more of the hand-rabbled reverberatory furnaces; (3) it might be treated separately, without further roasting, by some hydro-metallurgical process.

The first method has the advantage of simplicity, but as the gases leave the McDougall furnace at about 180° C., all antimony trioxide driven off would be collected by the Cottrell treater and, since it cannot remain in the furnace on account of the high temperature it would accumulate between the outlet of the McDougall and the Cottrell apparatus, making it necessary to clean the conduits quite frequently, thus causing great irregularity in operating the furnace. It was suggested that the gases be kept so hot that antimony trioxide would not be condensed during their passage through the treater, but this would have been a delicate regulation, and the furnace was not built so as to allow the construction of the Cottrell treater directly on top of it.

The second way, feeding the dust to other furnaces, has the disadvantage that a certain proportion of the dust would again be lost; and although this scheme on the whole would be feasible, and has been frequently practised here with dust caught in the dust-chamber of the McDougall, it is not practicable because it reduces the capacity in the other furnaces.

As the dust is a mixture of raw and roasted ore, it seemed practically impossible to obtain a satisfactory extraction by agitation with brine, cyanide, or hyposulphite solutions. Cyanide and hyposulphite failed to extract appreciable amounts of silver, but nearly 60% could be dissolved by a prolonged agitation of the dust with hot brine, to which a small amount of copper sulphate had been added. The residue of this agitation-leaching was treated by oil-flotation, yielding a product of 41 oz. per ton; this brought the total extraction up to 85%. Afterward an attempt was made to combine the two processes in one operation by agitation with brine and copper sulphate in the flotation machine and adding oil at the same time, but no mineral froth could be formed.

The proposed hydro-metallurgical treatment would therefore have consisted of the following processes: Agitation with brine and copper sulphate, precipitating the solution on copper and iron; decantation of the solvent and washing once or twice with water; oil-flotation of the residue, filtering and drying the concentrate and feeding it to the reverberatory furnaces together with raw ore.

The next step in experimenting with mechanical roasters at Machacamarca was the erection of a straight-line, one-hearth Merton furnace with five spindles. This type of furnace was selected because it fitted best in the plant, the hand-rabbled reverberatories having about the same dimensions. In order to get a good idea of the movement of the ore through the furnace, the ironwork was completely erected before the arch was built. Every spindle had but one rabble-arm, which was 5 ft. long, and the rabble-teeth were so placed on the arm that one-half of them project forward about 6 in. and the other half are 6 in. backward. These teeth are alternated, the object being to have the back teeth cut furrows in the ridges made by the front teeth.

In the modified straight-line furnace 85 sq. ft. of hearth-area is required to roast and chloridize one metric ton of ore with over 30% sulphur; in the McDougall furnace 58 sq. ft. of hearth is required, but 10 sq. ft. per ton is necessary to chloridize the product in a reverberatory, so that the capacity of the new furnace per square foot of hearth area is 20% less. If, on the other hand, the modified Merton furnace were built with step-bearings to support the spindles from below, instead of suspending them from the framework above, it would be feasible to drive the rabbles at 5 r.p.m. and to obtain a capacity of five tons per 24 hours, which would be one ton per 68 sq. ft., or exactly the same as the combination of McDougall and hand-reverberatory. But, even if the capacity were considerably lower, the quality of work done is so much superior that loss of capacity is not a great objection.

The intermittent system of working, of course, means a certain loss of capacity. The furnace is working at full capacity only when there is a charge of ore on every hearth; therefore, counting from the moment when a charge has been chloridized, it is working on two charges instead of three during 85 minutes. One-third of the time, or 28 minutes, must be considered as lost, since there are only two charges of ore in the furnace; as the time required for one complete cycle is 4 hours, nearly 12% of the capacity is lost. The difference in time needed to pass a charge of ore from hearth No. 2 to hearth No. 3 and that required to pass it from No. 1 to No. 2 is due to the fact that freshly ignited ore flows more easily than half-roasted ore.

Wherever it is important to obtain a uniform roast, the operation should be conducted in furnaces operated on the intermittent system. If anything goes wrong in a continuous furnace, several hours are required to restore proper working conditions, and in the meantime a product that is not suitable for subsequent treatment must be discharged. In addition to roasting for leaching, this system may be useful when roasting for magnetic-separation, or for differential roasting of complex sulphide ores preceding flotation.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

ROOSEVELT DAM POWER-PLANTS SUPPLY MINING COMPANIES.

BISBEE.—The Shattuck-Arizona company during the month of August is estimated to have produced 10,000 tons of lead ore, assaying 6.5% lead and 8 oz. silver, for treatment in the lead-concentrator which was erected two years ago. It is reported that an engineers' license bill, sponsored by the Arizona chapter of the American Association of Engineers, will be introduced at the coming session of the State Legislature. Under the provisions of this bill it will be necessary for all engineers engaged in professional business in the State to secure a license.

NOGALES.—Montana and Eastern capitalists are said to be interested in the famous Sheeby group of mines in the Santa Rita mountains. It has been announced that the new owners will take over the properties on September 1. This property is situated in the Agua Caliente region about 25 miles north-west of Nogales and 12 miles north-east of Tubac. A branch of the Nogales-Tucson short-line reaches within a mile of the mines.

BOUSE.—Development of a big water-power project on Bill Williams river by the Stene Consolidated Copper Co. is reported. The object of the proposed plant is to furnish power for the mines in northern Yuma and southern Mohave counties, and incidentally to irrigate thousands of acres of farm land.

MARICOPA COUNTY.—In the vicinity of Fish Creek station, on the road between the Roosevelt Dam and Phoenix, development work has been carried on for several years past on a property that is said to be the Lost Dutchman mine, which produced a great deal of coarse gold. Sinking has been in progress in an old shaft that was found covered over with mesquite timber on which had been packed earth and rock. At 100 ft. samples have been found returning assays of over $400 per ton. The ore is to be packed down to the main road on burros and then taken by motor-trucks to Mesa, the nearest railroad station.

MAIN SHAFT AND ORE-BINS AT THE MIAMI COPPER MINE

The receipts from sales of power generated at the Roosevelt Dam last year aggregated more than $400,000, and it is estimated that a 50% increase may be looked for in paid electric consumption during 1920. The Inspiration Con. Copper Co. has a 36-mile power-line, which connects the station at the Roosevelt Dam with the mine. The Inspiration company not only distributes

power to the mine, mill, and International smelter, but also supplies power to the mines and mills of the Iron Cap Copper Co. at Globe and the Magma Copper Co. at Superior.

GLOBE.—The Van Dyke shaft has been bottomed at 1692 ft. and the lateral development now will be started on levels at 1215 and 1550 ft. Ore on the dip was cut by the shaft at 1180-ft. depth, continuing 40 ft. It is understood to average 6% copper and is believed to be a continuation of the Miami orebody.

Over 300 men were called to the surface from both the Iron Cap and Arizona Commercial mines at Copper Hill last week when a fire alarm was sounded, and volumes of smoke appeared underground, leading to the belief that there was a fire in the mines. It developed, however, that the fire had originated on the surface near the collar of No. 2 shaft of the Arizona Commercial, due to a hot rivet being dropped on top of the shaft timbers. As the No. 2 shaft is a strong downcast, and both the above mines are connected, the smoke was drawn down No. 2 shaft and forced through both the Iron Cap and Arizona Commercial workings. The mine-rescue station was notified and a first-aid force rushed to the scene. However, before they arrived the fire was extinguished and no damage was done.

JEROME.—The entire Verde district is being surveyed for the United Verde and the United Verde Extension mining companies. This is the first time that a complete survey has been made. The Verde Combination is reported to be drilling on its Mescal claim and cores are said to be heavily shot with chalcopyrite. The diamond-drill hole which is being run from the 1300-ft. level has attained a depth of something over 450 ft. It is probable that a drift will be run into this ground if the indications continue favorable. The United Verde Extension now has two furnaces in operation, and the output for August is estimated to be approximately 5,000,000 lb. It is understood that the company has no plans for increasing production and may curtail further if the market for copper does not improve soon. The ore now being smelted averages around 14% copper and includes all the low-grade that is being mined on the 1700-ft. level. Reports received from the Shea Copper Co. state that the tunnel has been advanced a little more than 25 ft. beyond the point at which the raise to the shaft is begun and that more sulphide is showing in the face. The station has been cut for the raise and approximately 30 ft. has been made by the company employees, the remaining portion of the raise being done by contract. It is expected that the connection with the shaft 200 ft. above will be made in about two weeks and that by that time the tunnel will have been advanced to cut the orebody explored on the 325-ft. level.

COLORADO

[redacted] CREEK COMPANIES. NEW SHIPPERS AT IDAHO SPRINGS.

CRIPPLE CREEK.—The Golden Cycle M. & R. Co. has declared a dividend of $30,000, payable September 10 to stock of record August 31. The directors of the Cresson Consolidated Co. passed the September dividend owing to the low grade of the ore now being mined. The Reva G. M. Co., lessee of the Rose Nicol mine, on the north-west slope of Battle mountain, has found rich ore on the 10th level. The vein, just discovered, is believed to be the extension of one in the Captain system of the Portland property adjoining the Rose Nicol on the south and east. Samples taken across eight feet of vein-matter are reported to have shown a gold content of 15 oz. per ton.

CENTRAL CITY.—Taylor and Riddle of Rocky Ford, in sinking a new shaft on their Galatea and Summit claims on Banta hill, have exposed a narrow but rich seam of ore, that assays from 25 to 50 oz. gold per ton. The seam is widening and ore is being sacked for shipment.

Silver-gold ore containing from 4 to 6 ounces of gold per ton has been found by the Quartz Hill Consolidated Mines, Inc., in a cross-cut from the Argo tunnel driven to cut the Phoenix-Burroughs vein at depth.

IDAHO SPRINGS.—The first shipment from the Lone Tree mine in the Freeland district was made last week by the owners, Mayor Moscript and associates, of Idaho Springs. Nathan Shapiro and associates continue steady production from the Roosevelt. The mill is operated steadily on low-grade ore. A 10-in. vein assaying 2 oz. gold, 20 oz. silver, 4% copper, and 38% lead has been opened in the Hampton mine. A shipment is being sacked for consignment to the smelter. The Shafter mine of the Hudson Mining Co. is to be re-equipped with modern machinery and work is to be resumed as soon as the plant is started. The Shafter has a record for heavy production of ore of both milling and smelting grades.

OURAY.—Work is to be started on the Calliope mine, property of Charles Nix, in the Bachelor district. The property has been taken over by a syndicate formed by Max Grossman of Chicago. A mill for the treatment of low-grade ore is to be constructed and equipped, and development is planned. The workings of the Yankee Girl and National Belle mines are being cleaned out by the Diana Silver Syndicate, headed by Burton C. West of Denver and E. Johnson of Kansas City. It is planned to drift on the extension of the Tom Boy vein to its junction with the Laura Dinsmore vein.

MICHIGAN

RECENT IMPROVEMENTS AT THE QUINCY SMELTER.

CALUMET.—When normal conditions are restored in the copper-mining industry, several of the big Michigan producers, particularly Quincy and Calumet & Hecla, will enjoy the fruits of extensive improvements that have been under way for upward of a year. In this connection, attention is directed to Quincy's investments in its smelter and in a new hoist at No. 2 shaft. The hoist will make it possible to mine at much greater depth, while the changes at the smelter will materially reduce smelting costs. The smelter changes include a general remodeling of the plant, in which a new furnace, 16 by 32 ft., is being built. There have been installed in addition a 300-hp. boiler, a 22-ft. casting-machine which will turn out

shapes and anodes, a 12½-ton motor-crane to charge the furnace, a 6-ton crane to serve the casting-room, a slag-pot of 2½ tons capacity operated by a combination trolley and battery-locomotive, and an elevating-truck which will carry the refined copper from the casting-machine to the docks. The capacity of the new furnace will be 130,000 lb. in one charge, which compares with the present maximum of 55,000 lb. The total capacity of the improved plant will be 230,000 lb., compared with 140,000 at present. The casting-machine will be as nearly automatic as possible. The electric locomotive, operating on overhead tracks, will 'spot' the cars for the electric crane and the latter will pick them up and dump the mineral into the furnace. Charging of the furnace now is done by manual labor and is one of the most arduous tasks of the furnace-man, for it must be done in the face of intense heat. Altogether the smelter will contain the newest devices especially adapted to the requirements of a modern plant.

Copper shipments show a little improvement during the week with several comparatively large orders booked for Eastern concerns. One shipload, consisting of about 1,600,000 lb., went out from the Quincy and Copper Range smelters this week, and Calumet made a shipment to the East. There are no orders of importance booked ahead at Calumet's smelters, notwithstanding the fact that the furnaces are operating at capacity.

Coal shipments are coming into local ports with frequency and there appears to be little possibility of a fuel shortage next winter. Cargoes of 10,000 tons are arriving at the Calumet and Copper Range docks, while Quincy has sufficient fuel on hand and in sight to provide its employees with coal at cost. The same plan obtains at Calumet & Hecla and its subsidiary plants, and at the Stanton mines.

It was reported from the East that Osceola contemplated suspension, but this rumor has been denied here. It is announced that the only change during the past two weeks is the operation of the Osceola plant on one shift. This does not affect the Kearsarge branch and the difference in tonnage is negligible. Heretofore, hoisting was done on only one shift, the opposite crew being employed in development. Attention now will be centred chiefly in opening new ground so that quantity production will be possible when conditions improve. The present force is engaged entirely in drifting southward, both in Osceola property and in ground leased from La Salle. Under the conditions that have prevailed for nearly a year, Osceola makes this change advantageously. The same problem that confrots other properties, confronts this mine. It would be cheaper to suspend if such a step were possible, but, by keeping up development work, the way is paved for greater production and the nucleus of an organization is retained. Osceola's daily shipments average from 325 to 360 tons, while the daily shipments of the Kearsarge branch vary from 1350 to 1725 tons. Ahmeek shows a daily output in 'rock' of 2500 tons, or slightly better than the normal for the past six months. This is due largely to the fact that a number of Allouez miners and trammers were added to its force. Isle Royale's shipments are barely sufficient to keep its own mill operating at capacity, while Superior reports 1200 tons of 'rock' so far this month. White Pine, which it was announced a short time ago was about to suspend, is producing a comparatively small amount of copper and limited production likely will be the rule here in preference to complete suspension.

No. 4 shaft of Mohawk is approaching the so-called 'wide' spot on the 25th level, and within 60 days, or three months, the south drift should cut the freak section of the Kearsarge vein. This remarkable spot on the

A 'SLIDE' ON SHEEP MOUNTAIN, SILVERTON, COLORADO

three levels above was found about 1300 ft. from the shaft and it maintained the unusual width of from 35 to 40 ft. for a length of between 400 and 500 ft. The yield consistently ran from 22 to 25 lb. per ton for the entire distance and there is every reason to hope for a recurrence on the 25th and succeeding levels. Curiously there is comparatively little 'mass' in that particular section, although the other two operating shafts continue to produce a fair amount of native 'mass'. No. 4 shaft, as well as No. 6, is being deepened; the former is approaching the 26th level, and the latter is below the 17th. In No. 5 shaft, drifting north is going ahead and the usual amount of ground is being stoped. One of the most encouraging features of Mohawk's operations is the arrival of Italian workers, who are being given places underground. Most of the new-comers bring word that others are preparing to follow and there is reason to look for an improvement in the labor situation.

An improvement is noted in Mayflower-Old Colony's south drift. Besides containing a better grade of commercial 'rock', the vein is unbroken, which makes it pos-

sible to speed operations. There is no change in the raise in the west cross-cut and the same favorable showing that was revealed a fortnight ago still is exposed. Arcadian Consolidated is pushing its New Baltic shaft to the 600-ft. level with favorable progress. As soon as the sixth level is reached, which should be early this month, a cross-cut of about 15 ft. will be run to the vein. The lode will be opened 125 ft. before sinking is resumed. Two machines are operating two shifts per day, and it is planned to follow this program through the winter, with the 900-ft. level as the objective. From that point a drift will be started south to connect with the drift north on a corresponding level in he New Arcadian shaft.

NEVADA

SILVER PICK COMPANY AT GOLDFIELD ISSUES STATEMENT. PROGRESS AT EUREKA.

GOLDFIELD.—The south-east drift on the 358-ft. level of the Florence is 1050 ft. long and is within 100 ft. of where it is expected the southern extension of the main vein-system of the district will be entered. Work from the west cross-cut has been discontinued, but more work in this territory will be done when the treasury of the company is in better condition, according to reports. Florence lessees, mainly the Development and Cracker Jack, have sent 52 fifty-ton carloads of ore to the Development mill since it started June 15. Mill-returns have not been received by the Florence. The 250-hp., double-drum electric hoist formerly used at the Clermont shaft of the Consolidated has been sold to the Con. Virginia at Virginia City. Arrangements have been made to exchange Gold Bar Extension stock share for share for stock in the Deep Mines, an assessment of one cent per share to be paid by the Gold Bar Extension. This assessment will be paid by the company and not by the stockholders, as was done by the Consolidated. The Silver Pick has issued a statement to stockholders in which it is said "the lease on the Mohawk ground has so far been a disappointment, the ground so far opened up being very spotted and most of the ore developed being too low grade to be sent to the mill". This is a surprise to those interested in the company in view of the glowing reports quoting officials that have been published in the last six months. The report says: "Our superintendent reports, however, that the development so far carried on in the Red Top ground looks very encouraging to get on to a shoot of high-grade ore." In view of the two leases now held "it would be a strange thing if we did not run into a body of high-grade ore sooner or later", according to the report. An instance of a gold-mining company in India that is said to be planning to sink a shaft 6000 ft. from the present depth of 4000 is given as a reason why stockholders "will certainly feel that it is worth while to sink down another 300 ft. in the Silver Pick". The report declares "the mine in India shows that gold mining is nearly the same all over the world, sometimes everything looking very good and other times very poor. Nature seems to work the same everywhere. It is hoped that after reading over this letter carefully you will send us your proxy immediately." The proxy wanted is for a meeting to be held September 14 to increase the capitalization of the company from 1,500,000 to 2,000,000 shares. The 500,000 shares will be put in the treasury of the company and each stockholder will be given "a chance to subscribe to one-third of a share for every share he is holding on payment of six cents per share". The report closes: "One can never tell what developments we may make in the leased ground during the next 30 days to cause a rise in the stock." A carload of ore assaying $300 to $1000 per ton will soon be ready for shipment from the Meuli lease on the Lone Star.

GOLD MOUNTAIN.—At the 169-ft. point the tunnel of the Washington Gold Quartz entered a 5-ft. width of $8 ore. At 190 ft. an $18 assay was secured from a 2-ft. width. At 193 ft. a 6-in. width assayed 0.12 oz. gold, 13.48 oz. silver, and 12.2% lead. A fault, the second cut, was entered at 200 ft. and in a drift driven to find the vein beyond the fault there was secured from a 6-in. seam an assay of 0.5 oz. gold, $11.20 in silver, and 17.5% lead, or a total value of $43.08. A 50-hp. gas-engine and a three-drill, belt-driven air-compressor have been bought. More buildings have been erected, including a boarding-house; the roads have been repaired and the company soon will increase the force of six men now employed, according to J. K. Turner, a Goldfield engineer, who is in charge of the work.

EUREKA.—Shipments continue to be retarded by a shortage of railroad cars. Only development work is being done in the Croesus, where drifts are being driven in fault-fissures in a search for ore on the 200 and 400-ft. levels. Stoping has been discontinued until the ore-bins are again empty. The Holly recently shipped 200 tons of ore and more is ready for shipment when a new 50-ft. head-frame has been erected and minor repairs have been made in the shaft. The Holly is driving a cross-cut into the Bullwhacker territory. The Locan shaft of the Ruby Hill Development Co. has been unwatered. Four carloads of ore have been shipped and 600 tons remains in the bins. The Climax is shipping slowly ore extracted in driving the Mabel L tunnel and in drifting from it. The Prince recently shipped from the 150-ft. level a carload of $75 to $100 ore with a high silver and a low lead content.

SIMON DISTRICT.—A raise from the bottom level of the Simon Silver-Lead has been driven 100 ft. in "high-grade milling ore", according to a report issued by the management. This raise is in the hanging-wall orebody opened on the upper levels. The distance from the sixth to the seventh, or bottom level, is 150 ft. The Simon Contact, adjoining the Simon on the north, has opened "milling ore of good grade", on the 350-ft. level at a point 1400 ft. from the Simon Silver-Lead shaft, according to a report issued by that company. The ore was found in a drift in the extension into Contact ground of the main Simon Silver-Lead vein.

TONOPAH.—Ore 5 ft. wide and assaying $70 for this width has been found on the 400-ft. level of the New California Tonopah. This ore was opened in a vein parallel

to that from which the Tonopah Mining made shipments when that company worked the mine under an option. Ore is being shipped from the 400, 500, and 600-ft. levels at a rate of 50 to 70 tons weekly and it is planned to increase the output. The shipments are made to a Tonopah mill. There are two main veins, which have been explored to a depth of 700 ft., and a winze is now being sunk from the 700-ft. level. It is thought the two veins join at about 900 feet.

UTAH

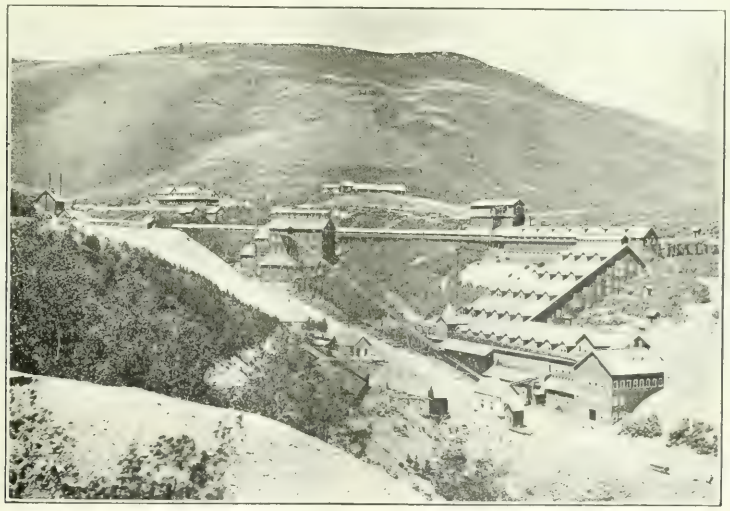
VIRGIN GROUND IN SILVER KING COALITION PROPERTY PROMISES WELL.

SALT LAKE CITY.—The thirteenth annual conference of the National Tax Association was held at Salt Lake City from September 6 to 10, inclusive. One session was devoted to the subject of mine taxation. A paper entitled 'Appraisement and Assessment of Non-Metalliferous Mines in Utah' was presented by Prof. William Peterson of the Utah Agricultural College, and Paul Armitage of New York, representing the American Mining Congress, presented an article on 'Net Income as a Factor in Mine Taxation'.

BINGHAM.—The new machine-shop at the Utah Consolidated Mining Co. is nearing completion, as are the new change-rooms. A large force of men is now employed in the grading and concrete work at the company's new concentrating plant in Pine canyon, near the International smelter.

PARK CITY.—Exploration of virgin territory at the property of the Silver King Coalition Mines Co. is pointing to the fact that productivity of ground hitherto unexplored should be as great as that of the older parts of the mine, according to M. J. Dailey, mine manager. On the 1100-ft. level a high-grade silver-lead deposit has been opened along the O'Brien fissure-system in a new ore-zone. Development between the 1300 and 1500-ft. levels suggests that the new ore opened up in the 'Blood' drift on the 1100-ft. level will persist. An important development is reported in the 'Brown' raise, between the 1200 and 1300-ft. levels, close to the Cavanaugh fissure. This work was undertaken in the hope of finding on the other side of a fault a continuation of the old 'Copper' stope orebody, which, in the early days, produced quantities of bonanza-silver ore. The exposure of high-grade ore in the Brown raise of a character similar to that mined in the old Copper stope, is considered an indication that this rich orebody has been picked up on the other side of the fault.

Shipments of ore from local mines continue to be curtailed on account of the shortage of labor; all properties reporting that many miners and shovelers could be given employment. During the week ending August 27, the Ontario shipped 620 tons; Silver King Coalition, 500; Judge M. & S., 419; Daly-West, 392; Naildriver, 115; New Quincy, 56; and the Keystone, 55, making a total of 2157 tons, as compared with 2279 tons shipped the previous week.



SILVER KING COALITION CONCENTRATOR AT PARK CITY, UTAH

A lease from the Little Bell Consolidated Mining Co. has been taken by the New Quincy Mining Co., according to A. L. Thomas, Sr., secretary and manager of the last-named company. By the agreement the New Quincy has secured the use of the Little Bell equipment, consisting of the hoisting-machinery, compressor-plant, boarding-house, blacksmith-shop, and other buildings. The Little Bell shaft has been sunk to approximately the same depth as the Daly-West 900-ft. level. The above arrangement will benefit the New Quincy company, as it will permit an outside entrance for underground work and will make the company independent in its supply of power and air.

Previously work done in the New Quincy ground has been carried on either from the Ontario drain-tunnel or from the Daly-West 900-ft. level, and power has been supplied by other companies. Under the new arrangement, ore can be taken out through the Daly-West or Ontario tunnel, and waste through the Little Bell shaft. The property of the Little Bell company is adjacent to the New Quincy and the Daly-West, and it is considered to be the last undeveloped mining property in the main part of the district. But 70 ft. lies between the drift on the Little Bell 900-ft. level and a raise being put up from a drift from the Daly-West 900-ft. level in the New Quincy ground to make a connection and work is being pushed to effect a junction as soon as possible.

EUREKA.—It is reported that the Knight interests have arranged to keep a pump in operation at the Ruby Hill shaft. A short time ago, work at the Ruby Hill shaft was stopped, owing to the difficulty experienced in raising money for additional prospecting, so if pumping operations are commenced now the shaft will be in better shape when the time comes to resume work. The water will be used at the Tintic mill where it is badly needed, and the milling company will stand the expense of pumping. The mill is now using about 200 gal. of water per minute for sluicing the tailing.

Stockholders of the Zuma Mining Co. are in receipt of a statement, covering the operations of the company for the year ending July 14, 1920. During that period the company expended $26,732, and did 898 ft. of drifting, raising, and sinking. P. J. Fennell, the president, states that lack of equipment at the property has been a serious drawback to rapid and economical development work. The main shaft should be deepened, if the ore showing continues to improve. Present work is confined to the 800-ft. level, where a well defined streak of ore is exposed. When the winze from the 800 reaches the 900-ft. level, drifts will be driven both north and south, on the ore-channel. The company at present has a debt of $22,000. More than 300,000 shares remain in the treasury, out of the original capitalization of 1,000,000 shares.

Shipments from this district for the week ending August 27 totaled 141 cars, of which the Chief Consolidated shipped 42; Tintic Standard, 29; Dragon, 12; Iron Blossom, 10; Mammoth, 9; Eagle & Blue Bell, 7; Grand Central, 6; Centennial-Eureka, 5; Iron King, 5; Bullion-Beck, 3; Grand Central, 2; Swansea, 2; Sunbeam, 2; Victoria, 2; Gemini, 2; Laclede, 1; Victoria, 1; Griggs-Huish Leasing Co., 1. This is an increase of 12 cars over the previous week.

The shaft at the Central Standard property, in the eastern part of the district, is now at a depth of 545 ft., and good progress is being made with the sinking. Delays have been experienced, owing to the fact that the porphyry formation, through which the upper part of the shaft was sunk, continually breaks timbers. There has been no trouble with water recently, as the reservoir on the 400-ft. level takes care of the water from above that point.

WISCONSIN

REVIEW OF OPERATIONS DURING AUGUST.

PLATTEVILLE.—The labor shortage in the district became so intense during the month of August that some operating concerns were barely able to operate. On this account the Wisconsin Zinc Co. suspended underground work at all of its producing mines, and in order to hold the working forces together special attention was given to the re-milling of tailing piles, and with some success. The number of shovelers especially was reduced to the minimum. At the Champion mine, the best producer in the Wisconsin Zinc Co.'s group, but six shovelers were at work when the mine was shut-down, whereas twenty-four men are required. Low prices for zinc ore contributed as well. Low prices sometimes can be met with maximum output but low prices in combination with a shortage of men is a difficult problem. Usually many farm-hands drift into the mines after the threshing season is over, but this year farmers themselves complain of the shortage of help so that little relief can be looked for from this source.

Prices for zinc ore were not satisfactory; the cost of production has been increased by the recent advances in freight-rates, and the higher prices for coal and power. The better grades of zinc ore opened at $49.25 per ton, base, 60% zinc-assay. No gain was shown on offerings until the third week in the month when the price was advanced on high-grade refinery blende to $53 per ton. The last week of the month sales were made on a base price of $52.50; the top price for the month was a little better than $55 per ton.

Deliveries of zinc ore were made for August, from mines to magnetic-separating plants, by districts as here shown, including shipments of lead ore.

District	Zinc, lb.	Lead, lb.
Benton	6,502,000	172,000
Livingston	5,056,000	.....
Cuba City	2,004,000	66,000
Day Siding	1,214,000	60,000
Galena	1,210,000	76,000
Shullsburg	862,000	66,000
Platteville	474,000	.....
Linden	276,000	.....
Hazel Green	234,000	.....
Highland	60,000	.....
Total	17,892,000	440,000

Shipments of the finished product from separating-plants to smelters were made for the month as follows:

Company	Lb.
Mineral Point Zinc Co.	4,960,000
National Zinc Separators	3,158,000
Wisconsin Zinc Co.	2,080,000
Block-House Mining Co.	296,000
Linden Zinc Separators	236,000
Total	10,730,000

Low-grade zinc-ore producers fared poorly all month, and operators who did not suspend piled up big reserves, which at the close of the month was conservatively estimated at more than 12,000 tons. The best price paid for the month was 80c. per unit of zinc in the ore, which

would bring 40% ore up to $32 per ton, but the penalties reduce this to about $30. The demand for open-market offerings was lax all month so that little zinc concentrate was sold in this market.

The higher offerings for lead ore, which became established at $110 per ton, about the first of the month, it was believed would stimulate operators to secure a higher production, but this did not materialize. Such production as was made was held closely and the sales reported for the month were few. Producers sensed even higher offerings and about mid-month some few sales were made as high as $115 per ton. The ore in reserve in the field is held in expectation that the price will eventually reach $125. Old workings and shallow mines were invaded by prospectors but without any appreciable increase in production. Shipments of pyrite fell to the lowest point ever known in this field. It was thought that, when the new acid-works went into commission at Cuba City, a demand of some strength would result, but so far as known none has developed.

The gross recovery of milled ore at mines for the month amounted to 8357 tons, the reserve stocks being reduced 639 tons. Net deliveries to smelters amounted to 5365 tons; carbonate zinc ore, 30 tons; pyrite, 65 tons. The raw ore was distributed with the Mineral Point Zinc Co., 3827 tons; National Separators, 3827; Wisconsin Zinc Co., 1431; Block-House Mining Co., 148; Linden Zinc Co., 130. The high-grade ore was disposed of to the Mineral Point Zinc Co.'s smelters at DePue, 3984 tons; Illinois Zinc Co., 641; American Metal Co., 534; Grasselli Chemical Co., 206. The Mineral Point Zinc Co. has been getting about 75% of all the high-grade blende produced.

Noteworthy undertakings are planned in the field by the New Jersey Zinc Co., following an official survey of the field by staff officers of the syndicate. The Zinc Hill Mining Co. has increased its capital stock from $300,000 to $1,000,000; two new mills are planned and an all-steel separator will be built. Several new mines are being developed and a sulphuric-acid plant at Cuba City is now making 40 tons of 60° Baume acid, which is marketed promptly in Chicago and Milwaukee.

LAKE SHORE MINE AND MILL, AT KIRKLAND LAKE, ONTARIO

BRITISH COLUMBIA

PLACER MINING IN PEACE RIVER DISTRICT IS ACTIVE.—NOBLE FIVE MILL IN OPERATION.

HUDSON'S HOPE.—The possibilities of gold-placer mining in the Peace River district is attracting a considerable amount of attention. A number of dredging-leases have been taken out by Chase & Stewart on Nation river, and the ground is to be thoroughly explored. Robert Woods has a couple of scrapers at work on Brenman flat and is said to have obtained good results. The Ingenika Development Co., a commercial company that has two power-boats plying on Peace river, proposes to investigate the gold possibilities of the Ingen river.

STEWART.—The Hyder Township & Improvement Co. is erecting a wireless plant at Hyder. The plant will be large enough for all commercial needs and will keep the district more in touch with the outside world. Cables have been stretched across the creeks in the Bear River valley at places where the bridges were washed away. This will give temporary relief in getting supplies for use during the winter to those camps that intend to operate. Hand-picked ore, taken from two dikes 15 to 25 ft. wide, respectively, at the Silver Tip mine, is being sacked for shipment.

SLOCAN.—The new 150-ton mill at the Noble Five mine was started on August 23, and is said to be giving satisfaction. The mill comprises jigs, tables, and Callow flotation-cells. With the exception of the Cunningham mill, at Alamo, it is the biggest mill in the Slocan region.

KAMLOOPS.—A local syndicate has bonded the Homestake mine, near here, and will start to develop the two eastern veins at once. The mine has been idle for more than 20 years. There are five veins on the property, all of which are said to contain medium-grade ore. The

syndicate will work the property in conjunction with the Mollie Gibson, and already has let contracts for a considerable amount of work.

TRAIL.—Ore-receipts at the smelter for the week ended August 21 amounted to 8911 tons, of which the Consolidated company's mines contributed 7253 tons. The other shippers were: Bluebell, Riondell, 314 tons; Josie, Rossland, 171 tons; Mandy, Le Pas, 1080 tons; Mollie Hughes, New Denver, 23 tons; Monarch, Field, 36 tons; and Venus, Cercross, Yukon, 34 tons.

TERRACE.—A good deal of prospecting is being done in this neighborhood, and some silver ore is being mined from several properties Some good-looking ore is being taken from the Kirkpatrick group, on Kirkpatrick mountain, Cedar river. E. F. Michaud is mining and sacking for shipment silver ore running up to $300 per ton from his property adjoining the New York group, and ore is being sacked from the New York group for a trial shipment. Mat. Allard is sacking ore containing both gold and silver from the Bear group. Bad transportation conditions are preventing much shipping.

ONTARIO

THE LAKE SHORE PROPERTY.—NIPISSING DECLARES REGULAR AND EXTRA DIVIDENDS.

PORCUPINE.—An important statement in connection with the option held by the Dome Mines on the Dome Extension has been forwarded to the shareholders of the Dome recommending the exercise of the option. It points out that a payable orebody has been proved to occur on the sixth level of the Dome Extension, that the ore-zone indicated by diamond-drilling on the 10th level of the Dome extends at depth into the Dome Extension, and that geological conditions show that other known ore-zones of the Dome, if they continue at depth, must dip into that property. The life of the Dome will therefore be considerably lengthened by the acquisition of the Extension, which is practically certain to be ratified by the shareholders.

Diamond-drilling is being carried on in behalf of British interests on the properties of the Ontario-Porcupine Exploration Co., situated in the south-western part of Mountjoy Township, within a mile of Timmins. A contract has been let calling for a minimum of 4000 ft. of drilling and a maximum of 10,000 ft. Little exploration has so far been done in this part of the Porcupine area, as it has a heavy overburden of sand, gravel, and clay, and trenching to rock is impossible. Success has attended diamond-drilling in other similar localities in the camp, and the operations of the company to ascertain whether the vein systems of the producing mines extend to this distance westward will be watched with interest.

MANITOULIN ISLAND.—A number of oil operators have for some time been at work on Manitoulin island with encouraging results. Some years ago the Standard Oil Co. secured a lease of 30,000 acres and drilled a number of wells, but afterward ceased operations. They have now returned to the field and are again at work. An English syndicate headed by Sir Stopford Brunton has leased 25,000 acres and is drilling. The Kyto Oil Co. of Dayton, Ohio, has found oil in three wells at a depth of 458 ft. and is producing steadily, and several other syndicates and individual operators are in the field.

COBALT.—Announcement is made that the Nipissing Mining Co. will disburse $600,000 to its shareholders on October 20, payment being made in the form of a regular 5% dividend, plus a bonus of 5%. This will make a total of $1,800,000 paid during the current year, and a grand total of $22,140,000 since operations started some 14 years ago. The total amounts to 369% on the company's issued capital. Announcement is also made that the company has purchased an iron mine within 35 miles of New York City.

Early in September, it is stated, the shareholders of the Temiskaming Mining Co. will be asked to participate with the McIntyre-Porcupine Mines, Ltd., in the purchase of extensive coal-lands in Alberta. It is reported that some of the shareholders favor dividend disbursements by the Temiskaming rather than the plan to go into the coal business, but heavy stockholders seem to favor the new venture. Arrangements have been made to explore the diabase sill on the Crown Reserve mine, and a diamond-drill machine will be operated from the fifth level for this purpose. Some small shoots of high-grade ore have been opened up on the old Lumsden mine, and the operators have been encouraged to carry on further exploration and development work.

KIRKLAND LAKE.—The Lake Shore mine, situated in the Kirkland Lake gold area, in Northern Ontario, produces higher grade ore than any other gold mine in Canada. The mill treats 60 tons of ore daily, and recovery has averaged about $24.90 from each ton since the mill commenced to operate in March 1918. The mine has been developed to a depth of 400 ft., the result of which has been to open up two important orebodies. One of these lies beneath the lake, and contains sections where the average gold content is exceedingly high, $50 assays being quite frequent over the width of an ordinary stope of from four to six feet. The deposition of the gold is not uniform, the ore-shoots beginning with low-grade material and gaining in richness gradually until exceedingly rich and then gradually falling off to low grade again. These shoots are from 100 ft. upward in length, and no difficulty has been experienced in developing ore far ahead of mill requirements.

It was recently decided to carry operations to a depth of 800 ft., the plan being to open up an intermediate level at a depth of 600 ft. This work is regarded as important, as a continuation of the ore to such a depth would necessitate doubling and possibly trebling the capacity of the mill. Operations are carried on with a force of about 60 men. Although this reveals the fact that but one ton of ore is treated for each man on the payroll, the amount may be expected to increase following the proposed addition to the mill. This performance compares favorably with the leading gold mine of Canada, the Hollinger Consolidated, where about 1½ tons of ore is treated for each man employed, but where operations are on a scale about 28 times greater than the Lake Shore.

CONFERENCE ON STANDARDIZATION IN MINING

The American Mining Congress has undertaken to organize a nation-wide movement looking to the standardization and improvement of mining practice as it pertains to mining machinery and equipment, cost-accounting, safety codes, devices for saving life and time, and co-operative methods as adopted by States and governments in behalf of operators and miners. The status of this movement was finally decided upon at a conference in Chicago on August 30 between officers of the Congress and the officers and representatives of several other organizations. The meeting was held in the Engineers Club, where the visitors were guests of Colonel Warren R. Roberts, who is general chairman of the coal division of th Mining Congress Standardization Committee. Two years ago the work of standardization was taken up by the American Mining Congress and the first committees appointed, with Colonel Roberts as chairman. At the St. Louis meeting of the Mining Congress last fall a three-days session of the sub-committees brought forth an exhaustive report, which later was printed and circulated among engineers and manufacturers. From that preliminary meeting there has grown the largest standardization organization ever developed, and now, with two general sections and subsections covering the various phases of the problem facing each division of the mining industry, the membership of the big committee exceeds two hundred specialists. Several meetings have been held to lay the groundwork for future programs. It was to consider how this new and powerful body could best function with established committees and with the most beneficial results that the Chicago conference was called. Dr. P. C. Agnew, secretary of the American Engineering Standards Committee, Mr. Sidney J. Williams, secretary of the National Safety Council, Mr. Bradley Stoughton, secretary of the American Institute of Mining Engineers, Mr. R. V. Norris, a director of the Institute, Mr. O. P. Hood, of the U. S. Bureau of Mines, Mr. J. F. Callbreath, secretary of the American Mining Congress, Colonel Roberts, of the standardization committee of the Congress, and Mr. John T. Burns, assistant-secretary in charge of American Mining Congress convention plans for the Denver meeting in November, were present and spent several hours going over the matter. As a result, a resolution was adopted requesting the American Engineering Standards Committee forthwith to organize a mining-standards committee composed of members selected by the bodies represented at the informal conference. The Mining Congress was urged to proceed with its work and it was announced by Colonel Roberts that plans were soon to be published for a great national conference on standardization, participation in which would be urged upon all bodies of mining and engineering men interested in the mining problems. "It is not the intention of this committee to in any way duplicate the work of existing bodies," said Colonel Roberts after the meeting. "There will be no competition and no friction. The American Mining Congress represents the industry because it is composed entirely of operators, hence, is the industry. We intend to take up and consider all of the standards that have been or may be suggested or adopted by either the Government or voluntary organizations and to make these standards operative and profitable. We will also propose changes and new standards as our committee by experience and contact with the actual conditions in the mines indicate their value or necessity. The standardization conference in Denver during the annual meeting of the American Mining Congress in November will be, I believe, one of the most important meetings ever held and its influence will be felt permanently in both mining and manufacturing. Among the most necessary things to be developed is to show how standardization has made wonderful progress possible in other lines and how the bituminous and anthracite coal men have materially strengthened their business standing by recent adoption of standardized accounting without which they might have suffered many embarassments during the strikes and wage conferences." The official invitation now being prepared is signed by Colonel Roberts as chairman of the general committee on the standardization of coal-mining machinery, Mr. Charles A. Mitke of Bisbee as general chairman of the committee on metal-mining machinery, and Mr. Richard A. Parker in behalf of the mining engineering profession.

ARIZONA

Yuma County.—D. M. DeLong, of Fresno, California, and Paul Kimball, of Salt Lake City, have taken over a number of mines in the old silver district in Yuma county. Representatives of the American Smelting & Refining Co. are reported to be making an examination with a view to purchase or lease.

CALIFORNIA

Nevada County.—A. A. Codd, of Reno has been inspecting the Morning Glory and Delhi group of mines near Columbia. ——A rich pocket was found in the Alcalde, formerly known as the Kenosha, a week ago in sinking a winze from the 400-ft. level. Two pieces weigh about 200 lb. and contain so much free gold that their value is estimated as high as $5000. The present company was organized by George W. Root and associates as the Alcalde Gold Mines, and Lloyd Root was placed in charge.——Mr. Coughlin, the county clerk, who was appointed as a Commissioner to determine the mineral or non-mineral character of Section 21, Township 18 North, Range 11 East, near Graniteville, has completed the taking of testimony. This section is a railroad selection and the Forest Service contend that it is more valuable for mineral than for agriculture. Expert testimony was introduced on each side.——The power shortage in Nevada county and in the Mother Lode section has been in no way relieved.

Placer County.—The Pioneer mine at Towle is closed until power is restored.——During a violent thunder-storm last week the lightning struck the 60,000-volt transformer at the Rising Sun mine near Colfax, and following the wires to the 900-ft. level shocked several miners unconscious, but did not otherwise injure them. The damage was $1000.

Shasta County.—The deed from the Bully Hill Copper Mining & Reduction Co. to the Shasta Zinc & Copper Co. for the Bully Hill mines has been filed for record. Revenue stamps attached show that the consideration was $433,500. By a bill of sale the Shasta Zinc & Copper Co. acquires also all the stock in the Sacramento Valley & Eastern railway connecting the mines with the Southern Pacific system. The

work of tearing down the Balakalala smelter to get structural steel for buildings of the Shasta Zinc & Copper Co. at Bully Hill is under way. Shortage of men retards the work. The first carload of material has been shipped to Bully Hill. It is well understood locally that the Shasta Zinc & Copper Co., which owns the Bully Hill mines at Winthrop, is negotiating with the Afterthought Copper Co. for the purchase of the Afterthought mine and works at Ingot. Ore in the Afterthought is refractory, but it is believed that it can be treated successfully by the new process being installed by the Jackling company at Bully Hill.

Siskiyou County.—M. Munz and associates of San Francisco have bonded a group of quicksilver mines near Gottville owned by Siskiyou county mining men. The lessees have a crew of 12 men preparing to erect furnaces on the property the coming spring. If the Gottville mines develop well during the winter the lessees will also work on other cinnabar prospects situated along the foothills of the Siskiyou mountains and along Klamath river.

NEVADA

Virginia City.—On September 6 it was reported that 350 miners at Virginia City and Gold Hill walked out, demanding a wage increase to $6 per day. The scale now is $5. The only large property in this vicinity not affected by the strike is said to be the Concordia. Miners declared an increase in the price of board made higher wages necessary. The walk-out is not sanctioned by the Miners' Union, it is understood, as the union has a working agreement with the operators which holds until January 1.

Obituary

John George Leyner was killed in an automobile accident near Denver on August 5. He was an American inventor of exceptional ability, a pioneer in the development of rock-drilling and mining appliances. He was born in Boulder county, Colorado, in 1860, being the first white child born

John George Leyner

in that county. He was the son of Peter A. Leyner. He leaves a widow and three adopted children. The mining industry owes much to his genius. To have had a part in reducing the cost of removing rock and ore, as he has done, is an achievement that places him among America's great inventors.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

George A. Deming was in Rhodesia recently.

Charles A. Mitke is visiting southern California.

E. P. Mathewson was recently at Warren, Arizona.

L. Maurice Cockerell has returned from London to Mexico City.

Harry W. Schumacher sailed from New York for Venezuela on August 21.

Karl Eilers, formerly associated with the A. S. & R. Co., is at Salt Lake City.

R. E. McConnell, of Los Angeles, is examining a prospect in Lassen county, California.

Harold A. Titcomb is expected at Palo Alto, California, where he will reside henceforth.

C. Erb Wuensch was at Aspen, Colorado, during the week. He returned recently from San Salvador.

L. C. Graton, geologist for the Calumet & Hecla Mining Co., has returned to Cambridge, Massachusetts.

Robert E. Tally, general superintendent for the United Verde Copper Co., was at Los Angeles last week.

Morris B. Parker is consulting engineer to the California Rand Silver Mining Co., at Randsburg, California.

A. G. McGregor, engineer and specialist in the construction of smelters, is in New York on professional business.

A. P. Anderson, of the U. S. Smelting, Refining & Mining Co., has returned to San Francisco from Juneau, Alaska.

Ralph E. Davis, director of the Wisconsin Mining School at Platteville, Wisconsin, since 1911, has resigned to move to New York.

R. M. Geppert has returned to Minneapolis from an adventurous journey to the headwaters of the Peace river, in British Columbia.

Robert S. Lewis, Professor of Mining in the University of Utah, has returned to Salt Lake City after a vacation at Huntington Lake in California.

Richard Roelofs, formerly manager of the Cresson mine, at Cripple Creek, and now residing at Colorado Springs, visited San Francisco on his way from Arizona.

S. F. Shaw has resigned as superintendent for the American Smelting & Refining Co., to become manager for the Compania Minera La Constancia at Sierra Mojada, Coahuila, Mexico.

N. Thompson, manager for Cammell Laird & Co., at Vancouver, B. C., is here for the purpose of obtaining data on the possibility of establishing an iron and steel industry on this Coast.

J. E. Burgess is making a geological examination at Oatman, Arizona, and will remain there to take part as an expert in forthcoming litigation between the Tom Reed and United Eastern mining companies.

Andover Syverson, for several years chief engineer for the United Verde Extension Mining Co., has severed his connection, and will take charge of the holdings of the United Arizona Copper Co., at Mayer, Arizona.

THE METAL MARKET

METAL PRICES

San Francisco, September 7

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	19.00
Lead, pig, cents per pound	9.25—10.25
Platinum, pure, per ounce	$115
Platinum, 10% iridium, per ounce	$165
Quicksilver, per flask of 75 lb.	$75
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

September 6.—Copper is inactive but steady. Lead is quiet and lower. Zinc is dull but easier.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence
Aug. 31	92.75	Holiday
Sept. 1	91.50	57.62
" 2	93.25	58.50
" 3	94.00	59.00
" 4	94.87	60.50
" 5 Sunday		
" 6 Holiday		

Average week ending	Cents	Pence
July 26	92.39	54.77
Aug. 2	92.85	56.20
" 9	94.58	58.39
" 16	95.39	59.05
" 23	99.12	61.60
" 30	96.61	60.70
Sept. 6	93.27	94.89

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	
Aug. 31	19.00
Sept. 1	19.00
" 2	19.00
" 3	19.00
" 4	19.00
" 5 Sunday	
" 6 Holiday	

Average week ending	
July 26	19.00
Aug. 2	19.00
" 9	19.00
" 16	19.00
" 23	19.00
" 30	19.00
Sept. 6	19.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.15	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	
Aug. 31	8.75
Sept. 1	8.50
" 2	8.50
" 3	8.50
" 4	8.50
" 5 Sunday	
" 6 Holiday	

Average week ending	
July 26	8.93
Aug. 2	9.06
" 9	9.00
" 16	9.06
" 23	9.19
" 30	8.85
Sept. 6	8.55

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.34	9.22	Sept.	8.05	6.02	....
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	
Aug. 31	8.15
Sept. 1	8.35
" 2	8.25
" 3	8.20
" 4	8.20
" 5 Sunday	
" 6 Holiday	

Average week ending	
July 26	8.22
Aug. 2	8.11
" 9	8.12
" 16	8.27
" 23	8.42
" 30	8.45
Sept. 6	8.39

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	
Aug. 10	88.00
" 17	85.00
" 24	80.00
" 30	85.00
Sept. 7	75.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	....
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

MONEY

A statement issued by Governor Harding, of the Federal Reserve Board, last week seemed to indicate that the management of our central banking system had been listening to criticism from quarters where restrictions on loans were disliked. Mr. Harding hastened to deny that the Board ever acted to discriminate between borrowers, and as far as differentiating between essential and less-essential loans, he said: "The Board is too far removed from the actual detailed situations involved to undertake to do this and has relied on the consistent information and judgment of the local banker to accomplish the Board's purpose sought."

The head of the Reserve Board reiterated the position taken last May, which was that the use of credit should be conserved by lending bankers, although in such a way that production of needed products and the accomplishment of business be not interfered with. The fact of close supervision and restriction of credit by bankers to customers has long been recognized in operation. There has been no secret about it. Bankers have discussed frankly the denial of new credit lines to many applicants and the limiting of existing lines to old clients. If such an attitude had not been taken it is fair to assume that, despite 6 and 7% Reserve Bank re-discount rates, there would have been further broad inflation of credit during the summer instead of the condition of stability, even of moderate contraction, which prevailed in most sections of the country.

Some critics of the Reserve Board and the Reserve Banks were inclined to become excited over Mr. Harding's observations. The argument was heard that the Board was misinformed on its own activities, and that tacit if not actual discrimination between classes of loans had been made at the fountain head of credit management. Doubtless the suggestions of the Reserve Board at the conference with the Federal Advisory Council and Reserve Bank Directors in May had a great deal of moral weight with bankers, but it is reasonable to believe that the direct apportionment of credit has been controlled solely by lending bankers themselves.

CURRENCY AND GOLD RESERVES

The amount of gold reserve of the United States available against notes in actual circulation on July 1, 1920, was more than three times that of any of the nations of Western Europe, according to information in 'Commerce Monthly'. This country had $2,234,000,000 in gold as against $4,512,000,000 in notes, giving it a reserve of 49.5% of the paper circulation, a ratio which also far exceeds that of any European country.

The nation most nearly approaching this country's percentage of reserve was Great Britain, whose gold holdings amounted to 31.5% of her note circulation, while France on the same date had only 9.6%. Germany and Austria had reserves of only 1.6% and 0.4% respectively. Italy, on September 30, 1919, the latest date for which data are available, possessed a gold reserve of only 7.8% of her paper currency.

Wide differences also are shown to exist between the total amount of notes outstanding in the various countries. The $4,512,000,000 of paper money in the United States compares with $16,104,000,000 in Germany and $12,559,000,000 in Austria-Hungary. Great Britain's note circulation on June 30, 1920, was only $2,258,000,000 and the French total of notes outstanding at about the same date was equal to $7,288,000,000. Italy on September 30, 1919, had $3,157,000,000 of paper outstanding. In giving these amounts the bank has converted the units of foreign currencies into dollars at their respective pars of exchange.

MONEY AND EXCHANGE

Foreign quotations on September 7 are as follows:

Sterling, dollars:	Cable	3.55¼
	Demand	3.56¼
Francs, cents:	Cable	6.97
	Demand	6.98
Lire, cents:	Demand	4.55½
Marks, cents:		2.06

Eastern Metal Market

New York, September 1.

All the markets are extremely inactive and sluggish but the price situation in most cases is steady.

Buying of copper is very light but basic conditions are bullish if anything and prices firm. Quietness pervades the tin market with the price tendency easy.

Prices of lead have declined as well as demand.

There is no life to the zinc market, though prices are steady.

Antimony is unchanged.

IRON AND STEEL

Prices and volume of business in iron and steel are still governed by factors which are out of line with the readjustments going on in other industries, says 'The Iron Age'. New buying is not large, but consumption is on a scale that promises well for operations in the remainder of the year and longer. Buyers and sellers recognize conflicting tendencies and find it hard to strike the balance. Testimony to a freer movement of steel products from the mills is definite. Accumulated stocks are being reduced.

While some Pacific Coast shipyards are bare of work, the two tankers just placed at Vancouver will give one Eastern producer 6700 tons of plates and shapes, while 1000 tons of angles go to a steel works on the coast. There is a report, not yet confirmed, that the Standard Oil Co. will build 17 tankers, of which 12 will be placed with Eastern yards.

COPPER

There has been no change in this market so far as activity or prices are concerned. Buying by domestic consumers continues very light, but there are constantly some foreign orders being put on the books. There are no signs of any easing in prices, the leading producers adhering strictly to the 19c., New York, quotation for both Lake or electrolytic copper for delivery through October. They appear not to be anxious to do any business, possibly anticipating that present conditions and higher costs will force a higher price when demand picks up. Consumers also are apathetic, either because they are comfortably provided for or expect lower prices. The expectation is that because consumption is very heavy, stocks in consumers' hands will soon be cut down to the point where buying will be necessary and that such a moment is due by the middle of September. In the outside market small lots are available at around 18.50 to 18.75c., New York, but offerings are not heavy.

TIN

This market has again passed through a very quiet week. Consumers are showing a little more interest, but this has not yet developed into buying on their part. Neither are sellers forcing their metal. Some future shipment business developed last week at around £285 per ton for a London seller, but this demand was spasmodic and did not broaden into further activity. It is known that consumption of the metal is heavy, but it is difficult to reconcile this with the absence of buying, unless invisible stocks are larger than figured. More business was done on the New York Metal Exchange in the last week than in some time, but it was not large, totaling about 175 tons, the last sales on Monday having been put through at around 46c. This compares with 48c. a week ago, and the decline of about 2c. has been a matter of comment. It cannot be explained by lower exchange and lower markets in London, as these do not obtain at present, but it may be due to nervousness by some sellers who may have offered some metal. Spot Straits tin is quoted today at 45.75c., New York, with the London quotation at £280 per ton as against £271 15s. a week ago. The quotation for spot standard tin there today was £272 per ton with future standard at £279. The Singapore quotation Monday was £289. Arrivals thus far this month have been 5075 tons with 4270 tons reported afloat.

LEAD

Contrasted with only a few weeks ago the market is very quiet and dull and values have receded further. Today both the New York and St. Louis markets are on a par at 8.75c. with demand light. Consumers are withdrawing, expecting apparently that lead will decline still more. This situation had developed as a result of the improvement which has been of fair proportion. This material is available at 8.75c., New York, for prompt delivery, and it is a fact that it can be imported at no more than 8.50c., New York, duty paid. Prompt American lead is held and sold at 8.87½ to 9c., New York, against 9.25 to 9.37½c. a week ago. The present situation is not unexpected and was even predicted some weeks ago. The leading interest continues its quotation at 8.75c., St. Louis, or 9c., New York.

ZINC

The market has undergone very little change. The offerings of re-shipment prime Western metal from England still hang over it and this is obtainable at 7.90 to 8c., New York. While some business is reported done, it is not believed to be large yet. Certain difficulties attend it, such as the identification of original parcels, as otherwise a duty is imposed. This may retard much buying of this nature. The import movement has not affected the Eastern market yet and may not. It is pointed out that most of the business in this immediate market is in brass special and other high grades and that the imported metal cannot compete effectively or seriously, at least in Western markets. The domestic market for prime Western is quoted largely nominal at 8.10c., St. Louis, or 8.45c., New York, with demand very light from all consumers.

ANTIMONY

The market is unchanged with wholesale lots for early delivery quoted at 7c., New York, duty paid. Jobbing lots rule at 7.25 to 7.50c.

ALUMINUM

There are fairly liberal offerings of Swiss and Norwegian aluminum at around 32c., New York, but demand is light. From the leading interest wholesale lots of virgin metal, 98 to 99% pure, are quoted at 34.90c. f.o.b. producer's plant.

ORES

Tungsten: There has been more business reported than in some time, but prices have not advanced. The foreign market is reported to have gone higher. Quotations here are $5.25 to $5.50 per unit, with Chinese ore nominal at $5 per unit.

Ferro-tungsten is unchanged at 90c. to $1.05 per pound of contained tungsten, depending on the grade and condition.

Molybdenum: The market is quiet with quotations nominally unchanged at 75c. per pound of MoS_2 in regular concentrates.

Manganese: No business is reported but the market is easier with high-grade ore offered at 65c. per unit, seaboard. Supplies for the ferro-manganese industry seem ample at present.

Manganese-Iron Alloys: The market is quiet with very little business in ferro-manganese or spiegeleisen. British ferro-manganese is offered at $170, seaboard, for delivery into June 1921, and American alloy can be had on the same basis. Sales are confined to small lots. One British maker refuses to meet the new price, having rejected an offer of $170, seaboard, on a 1000-ton inquiry. Spiegeleisen is firm at $80 to $85, seaboard.

INFORMATION FURNISHED BY MANUFACTURERS

WIRE-ROPE SLINGS FOR INDUSTRIAL PLANTS

'Roebling Wire-Rope Slings for Industrial Plants' is the title of a new catalogue that contains the latest information as to the various types of wire-rope slings which are now used in shop and field for handling heavy loads with safety. Numerous illustrations show some of the most recent developments of wire-rope slings as a substitute for manila, chain, and ordinary wire-rope slings. The depreciation of the manila-rope due to exposure and wear, and the uncertainty of the chain-sling due to welds and fatigue of steel are so well known that the safety and reliability of wire-rope slings are emphasized. It is general practice to anneal a chain-sling after it has been in service a short time and there is quite a general impression that such annealing removes all fatigue of metal and restores the chain-sling to its original efficiency. This is a fallacy, for fatigue of steel cannot be removed in the annealing-furnace. The breaking of the chain-sling without warning indicates that the fatigue of steel has reached the critical point. The Roebling wire-rope sling will show by inspection of the surface the approach of the critical point of fatigue and at the same time will have sufficient reserve strength to safely carry the load. Due to the high strength wire used, the factor of safety is approximately twice that of chain, so the fatigue of steel is not so rapid.

The surface indication of fatigue of steel in wire-rope slings is the breaking of the individual wires. For heavy loads the slings are fabricated of seven strands of 37 wires, 6 strands being twisted about the centre strand, each strand having 18 wires on the outside and 19 wires of the inside. The 18 outside wires, due to their location, are subject to the abrasion and most severe shocks and therefore show fatigue first, giving direct warning of sling depreciation. In the manufacture of Roebling wire-rope slings only blue-centre steel wire rope is used, a rope made from an extra high-grade steel of such physical qualities that it excels all others for strength and toughness. All endless rope slings are made endless in what is termed 'grommet' construction instead of by splicing. The spliced endless sling is not practicable for general service, due to the fact that it is impossible to protect the rope at points where the six tucks are made. When these tucks are in contact with sharp corners they are displaced and the strength of the sling is therefore reduced and deterioration becomes rapid. The endless grommet is made from one piece of strand and therefore contains only one tuck, occuring at the point where the two ends of the strand are tucked in and form the centre strand of the rope. The point where the tuck occurs is always placed on the equalizing thimble and therefore is fully protected from all abuse.

CATALOGUES FOR ROUGH USAGE

Catalogues issued by manufacturers of machinery, plumbing supplies, automobile parts, etc., are frequently handled by machanics whose hands are soiled by grime and dirt. The covers soon become so soiled that anyone having clean hands or dressed in 'good' clothes dislikes to handle the book. For a permanent catalogue of this type, a cleanable cover-material is desirable. For many years such a thing was unknown, but the art of stamping and pasting the edges of pyroxylin-coated book-cover materials was perfected a few years ago. It is now possible for any manufacturer to have a catalogue-cover from which grimy spots can be washed with soap and water without injuring it. The leather substitute is durable and will generally remain sound throughout the life of the catalogue. The cost is necessarily higher than for paper or cheap-cloth covers, but is not so high as to be prohibitive if a manufacturer desires a really permanent catalogue; one that will last and remain in good condition for several months.

BELT-CONVEYORS

A recent attractive publication is 'Conveyor Problems and their Solution', by the Main Belting Co., manufacturers of Leviathan-Anaconda belts. An interesting feature is the summary of the important advantages of belt-conveyor systems over other methods of handling material. They are as follows:

1. Large Capacity. A belt-conveyor has greater capacity than any other type. This is because the capacity of any conveyor depends largely upon the speed at which it may be operated. Speeds of 600 ft. per minute are not excessive for the wider belts, while even with the narrower belts, speeds of 200 or 300 ft. per minute are attained without danger of spilling the material carried. These high speeds enable the belt-conveyor to handle tremendous quantities of material, so that for all practical purposes, belt-conveyors may be built to handle any capacity desired.

2. Power Requirements. Where belt-conveyors can be used, it is not economical to use screw-conveyors or flight-conveyors, otherwise known as scraper-conveyors. Each of the latter consume about twice the power of a belt-conveyor and their capacity is much smaller in comparison.

3. Small Maintenance Charges. The greatest advantage of a belt-conveyor is its extreme simplicity. There is no complicated machinery to get out of order and if the proper attention is given to the belt the total cost of upkeep is extremely moderate even taking into consideration the cost of replacing the belt from time to time.

4. Accessibility. The rollers are compact units in themselves, easily accessible when properly installed; and repairs, when necessary, can be made in a short time. The belt itself is in plain view, so that its condition is always apparent, and for that reason it cannot give out unexpectedly.

5. Protection of Material. A wide variety of materials may be carried with the maximum of safety on belt-conveyors. In the case of foodstuffs there is no danger from contamination by oil or grease since the material comes in contact only with the belt, and remains stationary upon it after loading until the point of discharge is reached; very little breakage of material occurs. This is important where the material is of such a nature that a reduction from large to small size decreases its value. This condition is met with when conveying sized coal, for example.

6. Flexibility in Loading and Discharge. The material

may be loaded on the belt at any point in a variety of ways, either by spouts, mechanical feeders, or by hand, and is discharged either at the end or at intermediate points by means of trippers.

7. Light Weight. Capacity considered, a belt-conveyor is lighter than any other type of conveying equipment. This makes it desirable where the machinery has to be carried on trusses, as in the case of a conveyor carried on a bridge-truss between two buildings. The lighter the conveyor, the lighter may be the construction of the bridge, with consequent saving in cost.

8. Freedom from Shut-down. Compared to screw and flight or scraper conveyors, there is practically no danger of shut-down from choking due to the material becoming packed. When a shut-down does occur, it is of short duration.

DECISION IN DEISTER PATENT SUITS

The U. S. District Court of the State of Indiana has affirmed the decree of the lower courts in the action of the Deister Concentrator Co., appellant v. the Deister Machine Co., appellee. The following is quoted from the opinion:

"Appellant attacks the decree upholding certain claims in three patents covering improvements in concentrating tables, asserting that all the patents are invalid, and that its structures do not infringe any of the claims involved . .

"Various types of concentrating tables were well known to the trade in 1912. Some were covered by patents, and certain factors in the successful operation of all concentrating tables were well recognized at that date. Among the well known types were the Gilpin County Bumping table, the Gold Coast of Africa table, the Overstrom table, and the Butchart Bent Riffle table.

"From these types, as well as from various patents, we find that riffles were old, resistance planes were old, the reciprocal longitudinal movement and the tipping or tilting of the table were all well known and had been commonly practised for many years prior to the appearance of appellee's tables.

"Appellee's predecessors in title were far from pioneers in the art. They conceived and worked out, however, what they assert was an improvement over other tables. Their new table, which was a combination with most of the elements old, possessed merit because of the location and construction of these elements. A new element was added which, co-operating with the others, doubled, so it is claimed, the capacity of the table without increasing the loss in the tailings, secured a cleaner and greater quantity of ore values and reduced the item of labor cost. There is some evidence to support these assertions. That an increased capacity without loss in the tailings resulted is not seriously disputed . . .

"Appellant insists that, nevertheless, inventive skill was not disclosed. For having discovered the value of the plateau and the incline leading thereto as disclosed in the earlier patents, Deister exercised nothing but an ordinary degree of mechanical skill in making use of successive plateaus. But this is not merely a case of using successive plateaus. The use of each plateau is inseparately connected with the location and the height of the riffles on each plateau, the motion of the tables and use of the water, etc. It is a combination where each element works in conjunction with the other elements.

"In practical operation we find results perhaps not unlike those found in the tables covered by the patents just considered, but, clearly, the steps differ by which the results are attained. In this table an earlier stratification was sought. This was better accomplished by the level table. The inclines leading to the plateau made it possible for the table to be practically level. The incline found in the table in the patents just considered is absent. Stratification on the plateau and on the main surface was therefore accelerated and also more complete. The abrupt inclines leading to the plateaus operated as effective resistance planes that cut off the gangue and prevented it from passing forward at this point.

"We cannot say that this specific structure, designed to meet a specific problem, was but an exercise of mechanical skill."

COMMERCIAL PARAGRAPHS

The Deister Machine Co. has donated one of its 'Plat-O-Table' concentrators to the University of California for use in its mining department.

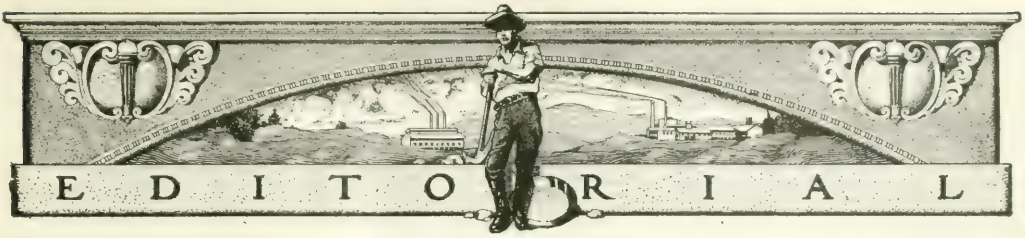
The firm of **Frost & Wurgler,** assayers and metallurgical chemists, succeeds Oscar J. Frost, assayer, of Denver. Mr. Wurgler comes direct from the employ of the American Smelting & Refining Co. He devoted 17 years to assaying, chemical, and research work at its Perth Amboy, Globe, and Durango plants. Mr. Frost counts on continuing his active duties with the firm.

Extensive improvements are under way at the plant of the **Pollak Steel Co.,** Marion, Ohio. The improvements consist of several new buildings and new equipment, the total cost running into a large sum. The products of this plant consist of rolled steel bars ad shapes, concrete reinforcing bars, etc. These new improvements are being made to take care of increased production and to cope with the volume of business going to the Marion plant.

Abbot A. Hanks, chemist and metallurgist, has moved his laboratory plant to 624 Sacramento street, San Francisco. Enlarged floor space (about 5500 sq. ft.) has made it possible to transfer the testing equipment of R. E. Noble & Co., whose business was purchased by Mr. Hanks some four years ago, to the new quarters. The activities of the enterprise now include metallurgical work, cement testing, concrete testing, the inspection of rails, machinery, pipe, timber, and other equipment, and sampling work at smelters at various points. Nearly 20 men are employed.

An instructive bulletin, No. 41311, from the press of the **General Electric Co.,** covers the subjects of power-factor correction and more recently, power-factor control through synchronous condensers. For power-factor correction a synchronous condenser always operates over-excited, or supplies leading kva. to the system; and for power-factor control it is regulated automatically to maintain constant receiver voltage, the starting and stopping being made dependent on load and power-factor conditions or a time clock. It then may operate either over-excited or under-excited, supplying leading or laggish kva. to the system. Particularly interesting sections of the bulletin are the data on power-factor, causes and effects of low power-factor, and the application of the synchronous condenser, with several calculations both for power-factor correction and control.

The Uehling Instrument Co., 71 Broadway, New York, has just issued bulletin No. 111 describing 'Style U Uehling CO_2' equipment. The design is new, being built in single and multiple forms, the latter serving any number of steam-boilers simultaneously, up to a total of six. The purpose of this equipment is to save fuel by burning it with the proper air-supply. Neglect of this factor is costing power-plant owners heavily. Among the features of the new machine are speedy action, resulting from a new form of aspirator, absence of chemical solutions, greater simplicity, and the unique plan of providing an auxiliary boiler-front 'CO_2' indicator, which guides the fireman, while the recorder, installed in the chief engineer's office or superintendent's office, makes a continuous (not intermittent) record showing all changes in boiler adjustments that are conducive to either waste or economy.



T. A. RICKARD, - - - - Editor

THE check to the manufacture of automobiles is significant. It is due principally to the action of the Federal Reserve Bank in declining to finance loans secured by sales on the instalment plan. One phase of extravagance after another will have to be abated in the general process of deflation now imminent.

IMMIGRATION is lively, but so also is emigration. From July 1919 to March 1920, inclusive, a total of 265,318 aliens landed in the United States, but during the same period 227,544 left our shores, so that the net gain was only 37,774 in the nine months. In 1914 the total of those arriving was 1,218,000. Recently as many as 17,000 arrived in one week at New York, but the conditions prevailing before the War are far from being restored.

FROM Washington comes the announcement that an experiment station is to be established by the U. S. Bureau of Mines at Rolla, Missouri. It is proposed to conduct research in connection with the lead and zinc mining industries of the Mississippi valley, more particularly the treatment of oxidized lead ores such as are found in certain districts of Missouri. This station, it may be assumed, will be conducted in friendly association with the School of Mines at Rolla, an institution that has turned out many successful and honorable members of the mining profession.

A LETTER dated July 18, 1914, has just reached us from Simferopol, in the Crimea, from a young Russian mining engineer who used to be in Colorado. It speaks volumes for the disorganization of Russia that a letter should be six years late in arrival, and it suggests that many letters written during the War failed of delivery. One does not need to be either generous or imaginative to wonder what has happened to the sender of this letter. Is he in General Wrangel's army? did he join the Czar's troops when War was declared, two weeks after he wrote? or is he numbered among the unregarded slain sacrificed in the Russian people's misdirected effort to gain political and industrial liberty?

APPARENTLY the Bolsheviki are as capable in mining as they are in governing. It is reported, in the 'New York Times', that they have been unable 'to carry out more than part of their 1920 program for mining gold and platinum in the Ural and the West Siberian regions of Russia''. They proposed to produce 4000 pounds of gold and 3000 pounds of platinum in 1920, but in six months this year they mined only 192 pounds of gold and 241 pounds of platinum. We suspect that it was 'poods' and not 'pounds', but that is a minor detail, the chief point being that they did not come within sight of their ''program''. One reason is a shortage of labor. Conditions of living under the Red rag are not as comfortable or as healthy as promised.

VIRGINIA CITY is the scene of the latest strike. Several hundred miners have 'walked out', compelling the cessation of work at many mines, with the object of forcing the managers to give them an increase of a dollar per day, that is, $6 per shift. This is not an opportune time to engage in systematic idleness, but the worse feature of the strike is the fact that it is outlaw, that is, unsanctioned by the union to which the men belong. This union has an agreement with the operators that does not expire until January 1, 1921. Naturally the operators exclaim that the cost of mining just now is excessively high, whereas the cost of living is coming down, and is certain to decline further, but the chief objection to the strike is that it runs counter to the principle of collective bargaining. If the men make contracts collectively and then break those contracts individually, they stultify the whole idea of unionism and compel the employers to work on the 'open shop' system. Nothing could be worse for the laboring man. If he will not play the game honestly, he deserves none of the winnings.

WE take pleasure in publishing this week a description of sundry novel smelting practices in Siberia. It has been our experience that most of the unusual or novel methods introduced into the art of metallurgy originate at the smaller plants, especially at those that lack the ordinary means of communication and transport. This is natural. The large smelting companies endeavor, either by the graduated tariffs of the custom plants, or thanks to the preliminary ore-dressing of private companies, to supply their furnaces with an ideal charge, whereas the company working alone must make the best of what it has, often with instructive results. The feeding of comminuted coal through the tuyeres has been introduced recently into blast-furnace work in this coun-

try and was hailed with considerable enthusiasm as a great improvement, although it seems that only a third of the coke can be substituted advantageously by coal, yet here comes Mr. H. C. Robson with a description of the practice at Spassky where the substitution is complete and the amount used compares favorably with reverberatory practice. The last decade has been marked by the success of the reverberatory in rivalry with the blast-furnace, and if the shaft-furnace is to retain its vogue it must be improved. We believe there is opportunity for this. Mr. Robson points out some of the possibilities, even though all his suggestions may not be applicable to American conditions.

NATURALLY the first delivery of mail by aeroplane from New York has aroused enthusiasm. The aerial mail-carriers have had troubles of one kind or another, and the service cannot as yet be said to be running punctually or smoothly, but that must be expected in the beginning of such an enterprise. It is only eleven years since man's conquest of the air was acclaimed in the person of Louis Blériot, when, on July 25, 1909, he flew across the English channel, from Calais to Dover. Blériot's machine was a monoplane propelled by a 25 horse-power Anzani motor. Since then the aeroplane has been enormously improved in design, speed, and safety. We note that plane No. 151, piloted by Mr. P. J. Murray and arriving in San Francisco on September 11, brought a copy of the 'New York Times' of September 8. That is a happy augury. When Blériot crossed the Channel he ended the isolation of England, and it may well be believed that he did something to diminish the insularity of Englishmen. The delivery of the 'New York Times', one of the best, if not the best, newspaper in our language, within three days of publication is significant. It shortens the intellectual link that binds us to our friends in New York; it promises to lessen the provincialism or sectionalism that marks both sides of this continent; and, above everything, it gives us the lively hope that the day is near when, instead of reading De Young's 'Morning Howl' and Hearst's 'Yellow Yap', we shall be able to read a newspaper that not only gives its readers "all the news that is fit to print" but accompanies it with interesting comment and intelligent criticism.

ONE of the best means of learning wherein the conduct of mining and metallurgical enterprises in foreign countries excels our own is "to see ourselves as others see us". To this end we publish in this issue an article that originally appeared in an Australian review and was written by an Australian for the enlightenment of his countrymen. Although the tone of this article is, for our purpose, a little too complimentary, the points that most attracted the author's attention must have differed in degree or kind from the practice to which he was accustomed, and therefore deserve attention. He points out that simplicity should never be forgotten in mill design. Many a method that has worked satisfactorily in theory has failed in practice because the fine balance required of the various operations could not be obtained under the rough conditions of actual practice. In his enumeration of the different schemes in use he fails to point out that gravity concentration and froth-flotation are not entirely distinct operations as his list would lead one to believe, that instead of being used in series they may be, and are, used in parallel on classified products, as is done at the Inspiration mill in treating the tailing from the 'rougher' flotation cells. His remark that ball-mills have come to stay overlooks possible successful competition by an improved rod-mill, and there is no mention of disc-crushers, perhaps because their use is more general in preparing ore for leaching than for concentration. Our use of more permanent forms of construction, for mill-buildings, is due not only to the cheapening of cement but also to the longer life confidently anticipated for the larger copper enterprises, which start with millions of tons of ore assured. We welcome such friendly comment as is offered in this article; indeed, we venture to say that our engineers in turn should make themselves better acquainted with Australian practice, more particularly in flotation, for which the metallurgists of Broken Hill have done so much pioneer work.

MECHANICAL energy essential to industry comes from three primary sources, namely coal, petroleum, and water-power. The need for the development of our water-power is not, however, based so much on an actual shortage in the supply of coal as upon its great relative economy. There has been mined in the United States 2.8 billion tons of anthracite and 9.2 billion tons of bituminous coal, while there remain untouched, according to reliable estimates made by the U. S. Geological Survey, 19 billion tons of one and 1500 billion tons of the other kind of coal. In addition, there is a fabulous quantity of lignitic coal from which energy may be obtained when it becomes necessary. The difficulty with coal lies in the fact that under present conditions one-third of the freight carried over the country is coal and we are not able to spare the trains to handle this traffic. There will be relief when the system of burning coal at the mines, to produce electric energy for widespread distribution, is extended. The burning of coal in thousands of scattered and isolated boiler-plants is highly wasteful, and the substitution of petroleum for solid fuel is hardly more efficient. From 1859 to 1917 there was produced in the United States 4.2 billion barrels of oil, leaving 7 billion barrels still to be mined. Considering the rapidity of increasing consumption, it is unsafe to count on this supply, even if helped by imports, to last more than twenty years. There remains then the one source of power that is replenished daily, namely, our streams and rivers. It is estimated that of 59 million available horsepower only 16.6% has as yet been harnessed. The development of high-tension electric transmission has made hydro-electric energy the most efficient form of power yet devised. The largest item charged against a hydro-electric plant, once it is erected, is the interest on the capital invested; and the uncertainty of tenure under the former Federal laws caused corporations to hesitate in

investing their money in such enterprises. The new regulations make reasonable provision for the protection of capital put into hydro-electric enterprises without jeopardizing the interest of the public, and there is evidence already of stimulated interest since the new law became effective last July.

Copper Production

It is generally assumed that the present depression in the copper industry is due to the cessation of European buying since the War and the consequent reduction of output by the producers to an amount much below normal. These mistaken ideas are in large measure dependent on the supposition that the production of copper in the United States has increased at a progressive rate of nearly 10% per annum, that is, not only has the production of copper increased but the rate has also increased. Statistics of recent production were given on page 383 of our last issue. The various tables published giving the production and increase by decades seem to confirm the idea, but plotting the figures by years will show that there have been four periods, in each of which the rate of increase in the production was fairly constant. The first, during which the plants took root, lasted until 1881, and developed an annual rate of increase of a little over three million pounds per annum; the second commenced with the introduction of electric lighting, lasted until 1895, and had an annual rate of increase of 20,000,000 pounds per annum. The third commenced with the general introduction of electric railways and lasted until the War, with a uniform rate of increase of 40,000,000 pounds per annum. The fourth period was that of the duration of the War and was one of supernormal production, not to be considered as forming any part of the normal periods. It is characterized by excessive expansion unwarranted except by urgent necessity. Adding six times forty millions to the production for 1914 (1,150,137,192 pounds) gives 1,390,000,000 as the hypothetical normal production for 1920. Actually it seems to be at a somewhat higher rate, say, 1,500,000,000 pounds. Thus, even with the great reduction from the war-rate, the production is still in excess of what may be considered normal. Omitting 1913 and 1914, exports had risen to 775,000,000 pounds per annum before the War. The figures for 1913 and 1914 are omitted because they indicate that Germany was already preparing for war by making large importations of copper, the apparent per capita consumption being 9½ pounds per annum in 1913 as against 7 pounds in the United States. Our exports have already reached the above pre-war quantity, and with the disorganized state of German monetary and industrial conditions it may be safely concluded that further increases will be gradual. In other words, the present rates of production and export are normal or nearly so. James Douglas pointed out, many years ago, the coincidence of the curves showing corresponding conditions in the iron and copper industries, but since the War this agreement has ceased. The production of copper for 1916-'17-'18 was nearly 60% greater than that for 1912-'13-'14, while the corresponding increase in the pig-iron production was only 38%. Whether this was due to greater foresight or greater difficulty in developing the industry is beside the question, but it fully accounts for the present large surplus in copper and the fact that the price of pig-iron is 250% above pre-war prices, while that of copper is scarcely any higher. In the face of these conditions and the large stocks, which represent fully eight months export requirements, it must be expected that the improvement in the copper industry will be slow even though it now seems probable that the next few years will see a new period of expansion marked by increased consumption of copper for the electrification of the railways and similar purposes.

A Question of Ethics

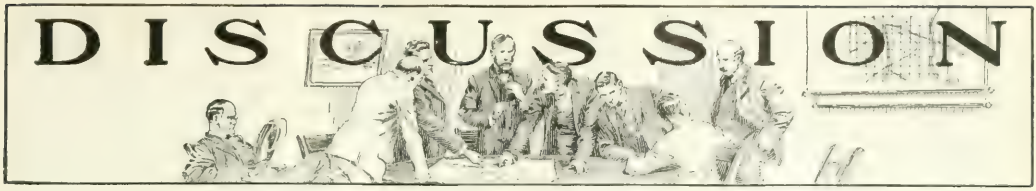
On another page we publish the correspondence with an advertiser who undertook to discipline us because we wrote something that did not please him. As a matter of fact he was an advertising agent, who, presumably, acted in accordance with instructions from his principals, a firm of manufacturers at Pittsburgh. For obvious reasons, we forbear from publishing the name of the firm, because it is no part of our province to pillory them or to make personal the remarks that follow herewith. The question is this: Is an advertiser warranted in attempting to dictate the policy of a paper by withdrawing his patronage as soon as the editor criticizes the utterance of a leader of his (the advertiser's) political party? In this case the advertiser objected to an editorial—it was the one on Senator Harding's speech of acceptance—because it had "a distinct Democratic trend". It had nothing of the kind, unless every criticism of a leader of one party involves partisanship with the opposing party. That our depreciation of Senator Harding's speech was not prompted by Democratic bias is something of which we are certain; and for confirmation we refer our advertiser either to Colonel George Harvey or to Judge Hughes, both of whom, we are confident, shared our opinion of the speech. Most, if not all, of the editors of independent papers in this country criticized the speech adversely, and one of the most competent of commentators, Mr. E. S. Martin, the editor of 'Life', found in it an easy target for his urbane humor. Of course, we could mount our high horse and protest loudly against the attempt to dictate to us, for it is obvious that if the Messrs. Blank had their way every paper in which they advertise would have to say only the things that pleased them. As our independence is not endangered by this breach of decorum, we need only state that the attempt will not be placed to the discredit of "the business interests" of the Republican party. Such tactics are not characteristic of any party, even though some persons inebriated by the exuberance of their enthusiasm should essay to make editors 'good' from their personal standpoint. This paper is not partisan in politics, but it does discuss political matters at a time when they are of national importance, for it is the

function of an editor to discuss what is interesting to his readers. We are not committed to the support of the Democratic candidate; on the contrary, we think that Governor Cox has made himself ridiculous over the alleged 'slush' fund and we know that his war record is open to grave reprobation, as, undoubtedly, the Republicans will try to demonstrate before the first Tuesday after the first Monday in November. Both presidential candidates, in our opinion, and in the opinion of other independent editors, are second-rate men, and it seems highly probable that the voters in casting their ballots will be guided more by party affiliations than by enthusiasm for either nominee.

Another, and equally important, question arises: Is it the function of an editor to please his advertisers, or to interest his readers? Of course, his main duty and his proper policy is to please the subscribers and readers by giving them what is interesting. To be interesting any writing must be true and it must be agreeably expressed, for misinformation soon ceases to excite curiosity, and truth embalmed in piffle is not appetizing. We go even so far as to say that the advertiser has no standing as a reader; as a matter of fact he rarely has either the time or the inclination to read the papers in which he advertises; even if he does, the fact that he is pleased or displeased is not a factor in the problem, which is, to print matter that will appeal not to him but to those among the subscribers and readers who are his clients or possibly his clients, that is, buyers of the things he advertises in the paper. Of course, if a paper were unpatriotic, scurrilous, or otherwise abominable, a man or firm would be warranted in ceasing to advertise in it, even if the paper had so large and so effective a clientele that the withdrawal of the advertising patronage involved a loss of business to the advertiser. In short, circumstances might lead a man to cut off his nose to spite his face, but usually it is unwise to do so. The kind of journalism in which we are engaged is clean and independent because we have no direct dealings with our advertisers. We—the editor—look to the subscribers. The business manager looks to the advertisers. If we print what interests our subscribers, then *ipso facto* the paper becomes an effective medium of publicity and the advertising pages become valuable to the manufacturer. The latter would be warranted in complaining if the editor failed to publish matter that engaged the attention of the kind of people to whom he appealed through his advertisement, but he is off his beat when objecting to something that does not please himself. If he happened to be a subscriber, he might cease to subscribe, but, if sagacious, he would not cease to advertise until he had reason to believe that the article or articles that displeased him were also so repugnant to many other readers as to cause them to reject the paper and thereby lessen its usefulness as a medium of publicity. The article that moved Mr. Blank to unfriendly action was not of that kind. It pleased many Republicans; it pleased many others, as we happen to know. We mention this only because it is part of the evidence in the case. As we said in our letter to Mr. Blank, we are sorry to have hurt his feelings; an editor occasionally writes something that annoys an individual; that is the inevitable consequence of frank criticism and the independent expression of opinion. It is possible to write amiable patter, to avoid contentious subjects, especially politics, to step so slowly and so gingerly as to tread on no corns, to ignore the realities of life; but that is not journalism, because it is uninteresting. The function of true journalism is to give the information on which correct opinion can be formed and to guide the formation of that opinion without fear or favor, with kindness toward all honest men, with malice toward none

A Grievance

The restrictions placed upon the use of electric power at the mines of this State are proving a serious handicap. A sweeping order has been issued by power companies at the instance of the controlling authority, namely, the Railroad Commission, to the managers of mines compelling them to decrease their consumption of power by at least 20% until such time as the rains come and there is a sufficient supply of the water used for generating electric energy. This 20% curtailment is enforced upon all mines regardless of circumstances, just as the increase in railroad freight-rates was granted by the Director-General of Railroads irrespective of local conditions. We referred last week to the hardship that the increase in freight-rates imposed upon sundry mines and sundry mining communities and how an appeal was made in Utah to the Public Utilities Commission of that State for the purpose of relief on intra-state shipments of ores. Indeed these blanket increases of rates, just like this blanket restriction on the use of power, argue a lack of intelligence, or an excess of laziness, on the part of those in authority. For instance, a small mine is running a small mill; one is dependent upon the other; unless the mill can be run full time, the work in the mine must stop. By the recent order the milling must be curtailed 20% and all this curtailment must be made in the 13 hours from 7 a.m. to 10 p.m. A mine is being unwatered, or the water in a mine is being kept down so that the breaking of ore can proceed on the lower levels; a diminution in the use of power means that the water rises and the work has to stop. In some cases it becomes impracticable to continue operations. We are referring to actual cases, not to imaginary ones. In any event, so many of the gold mines of California are idle on account of the high cost of labor and supplies, or the decreased purchasing power of gold, that it seems both unwise and unfair to place any fresh burdens or restrictions upon the industry. Moreover, while electric power is being denied for useful purposes, it is being expended in exhibits of 'electrical houses', thereby inviting the public to use it for a hundred and one non-essential purposes. Power is taken from the hills behind the mines and conducted to cities where it is used lavishly for illuminating all sorts of non-essential places and performances. It seems to us that in this instance the miners have a real grievance and that it ought to receive the sympathetic consideration of the Railroad Commission of the State of California.



Chuquicamata

The Editor:

Sir—On page 280, of your issue of August 21, I have read with interest the transcript of a description of the mines Chuquicamata by W. L. Schurz. There are one or two things in the article that I think are not quite right. He states in one paragraph, "belt-conveyors, more than 1000 ft. long, carry the ground ore to the large leaching-vats, where it is treated with water. There is sufficient sulphur in the ore to form copper sulphate without the introduction of sulphuric acid, although before this fact was discovered the company had installed an elaborate acid plant, since abandoned."

Having been assistant-superintendent of the leaching-plant there for two and one-half years from the time of the starting of the plant, I think that Mr. Schurz is somewhat in error in the paragraph quoted above. What he probably means to say is, that there is sufficient sulphuric acid obtained from the water-soluble copper sulphate in the ore by the regeneration of the acid in the electrolytic plant, to obviate the necessity for adding any manufactured acid; hence the abandonment of the acid plant. It would be a chemical impossibility for water and sulphur to combine and form sulphuric acid to dissolve the copper in the ore.

He has also left out a very important portion of the treatment between the actual solution of the copper in the leaching-tanks and the electrolytic deposition in the tank-house. Owing to the fact that the ore in Chuquicamata is a combination of water-soluble copper sulphate, the basic sulphate (brochantite), and the oxi-chloride (atacamite), with several other minerals of copper of more or less the same nature, the solutions obtained from the leaching of the ore contain an amount of chlorine in combination with copper as cupric chloride ($CuCl_2$). This chlorine has to be removed before the solutions are delivered to the electrolytic cells. This was done, at the time I left Chile in 1917, by precipitating the chlorine as cuprous chloride (Cu_2Cl_2) in a plant specially built for the purpose. Cement copper was added to the solution at the head of a series of agitation cells and the resultant cuprous chloride settled in Dorr thickeners. The clear liquor with chlorine contents reduced to from 0.5 to 1.5 gm. per litre was sent to the electrolytic plant. The reaction which took place can be expressed by the following formula: $CuCl_2 + Cu = Cu_2Cl_2$.

The cuprous chloride thus obtained was dissolved in a salt solution and the copper precipitated on scrap-iron as cement copper to be used in the dechloridizing of subsequent plant solutions.

At the time that I was there the copper was deposited on starting-sheets four feet square and the resultant cathodes, weighing about 250 lb. each, were delivered to the smelter. These cathodes were melted in oil-fired reverberatory furnaces and cast into regular wire-bars.

Denver, August 25. ROBERT CLARKE.

The Sampling of Mines

The Editor:

Sir—During the late discussion on this subject I have been credited (or debited) with an asinine statement that I would limit the applicability of methods of guarding against sampling-errors by means of bulk-samples to cases where errors up to 8% or 10% only were indicated. I have been accused also of trying to apply the idea to cases where it was not intended. Again, I am supposed to have introduced the issue of applying the method to ores of secondary enrichment. I have done none of these things.

I consider that the use of factors of safety becomes more imperative the greater the indicated 'errors' become. As to applying the idea to cases where it was not intended, I was not considering some special person's intentions. I was discussing the best ways of applying an idea. The idea of allowing for a sampling-error on results obtained by hand-sampling is not new. It was familiar to me as a youngster twenty years ago. It was not used under that name; but a proportion was deducted off the average assay-results when estimating the actual value expected to be won when the ore was mined. This allowance, where possible, was based on experience with similar ore; where such data were wanting, the allowance was based upon the judgment and experience of the engineer. It covered both latent sampling-errors and the adventitious admixture of wall-rock.

Mr. Webber has gone further and published a method of ascertaining the 'latent errors'. It seems he did so with special deposits in view. That is no reason why the idea underlying his method should not be applied to other deposits or why other men should not elaborate their own methods of applying the idea or why they should not offer suggestions that may affect Mr. Webber's method as set out by him. In fact, I agree with him in almost all he has written on this subject, and his articles have been most instructive. I do, however, consider that his method of taking governing tests (bulk-samples) at regularly spaced intervals means more work than may be necessary in many instances and that more attention should be given to establishing separate factors of safety for differ-

ent types of ore. Mr. Webber's last article (February 20) certainly largely repairs this omission.

Answering the third charge, I believe I never used the term "secondary enrichment". Certainly it was not in my mind as affecting this subject. I said that the division of the ore, for purposes of security against 'errors', should be based on differences of character of ore, not on empirically chosen measurements (as is done in hand-sampling). I said that such variations would occur mostly vertically, though not wholly so. I had especially in view the change from oxidized or weathered ore to primary or unweathered ore; not on account of enrichment or otherwise, but because of physical differences. These would affect the degree of accuracy of hand-sampling differently. Such ores therefore should have their governing tests made separately.

The following sets out briefly the case as I see it:

Bulk-sampling (whether in form of mill-tests or otherwise) by itself is insufficient. It ignores the law of averages, which is the very essence of sampling. It is not worthy of the name of 'sampling' when applied to a mass, heterogeneous in value.

Hand-sampling must be the basis of any valuation. The more samples (the closer they are taken) the more accurate is the result, other factors being equal. For a given number of samples, heavier samples will give more accurate results. For a given total weight of samples a larger number (smaller individual samples) will give the greater accuracy.

For every deposit or mine there is the happy mean, which combines reasonably accurate results with reasonable amount of work (cost). It is the art of the engineer to judge where that happy mean is. The above remarks do not allow for inherent 'errors' in sampling. If that allowance is not made, fewer samples of greater individual size might in some cases give a closer approximation to true values, because the smaller samples may have a bigger 'error' in each and so a bigger average 'error'.

Hand-samples are liable to errors. It is of the greatest importance to ascertain if possible the degree of those errors. The error in one type of ore in one deposit (or in similar and neighboring ones) may reasonably be expected to be more or less uniform.

The errors in different types of ore may be assumed to be different. If not, the fact is a coincidence. It is reasonable to expect such differences and to arrange the work on that assumption. The logical procedure, therefore, is to secure the sampling-error of each type of ore (if there is more than one in the case) separately. It is desirable in securing the error in each type to perform only such work as is sufficient for that purpose. In the absence of data obtained by previous operations and comparisons, the obvious way to secure the error is to compare results of hand-sampling with that of bulk-sampling, it being understood that the bulk sampling is so performed that 'error' is eliminated.

The obvious way to effect this is to take a bulk-sample in such a way and of such a size as to reduce the factors that cause errors in hand-sampling to a negligible quantity, and to enable the hand-sampling of it to bring sufficiently into play the law of averages. The whole bulk-sample being small in comparison with the deposit, and the number of hand-samples taken of it being small compared with the number taken of the entire deposit, greater care must be exercised in the hand-sampling than is the case with the general sampling. This "greater care" refers to dimensions of channel, etc. It must not be allowed to affect the average 'error' by introducing new factors of error. The same method of hand-sampling must however be used as for the general sampling. Channels should be of the same dimensions, and so on.

There is no reason why the error should vary in different parts of the deposit if the type of ore remains the same. If the character of ore varies in such a way as to preclude its division into a few types, the division of the deposit into regular areas, each one having its governing test made for error, may be necessary; otherwise only a sufficient number of tests are justified to establish the fact that any one type of ore has approximately the same error. The said number of tests suffice as against the average error to be applied to one type of ore. For example, if three tests give closely similar errors for one type, further bulk-sample should be unnecessary. If continued tests give results of more or less wide variation then bulk-samples should be taken until it is felt that the law of averages is satisfied. In the last case it would be advisable that the bulk-samples be taken at regular distances.

Except in cases like the last, the problem of ascertaining the sampling-error for a certain type of ore, is a totally different one from that of sampling a deposit, and the reasons for regular spacing and for large numbers that exist in the latter problem do not exist in the former. Indeed, in one type of ore in one deposit, one bulk-sample might indicate the 'error' correctly. I agree, however, that it would be better not to trust to its doing so.

In a case where areas of weathered and of unaltered ore could be dealt with separately, and where a zone of mixed material lies between them, the sites for bulk-tests for that zone would have to be chosen according to the circumstances. Also the area that each test governed would need to be specially considered.

It is as well to repeat that the above remarks regarding number of bulk-samples infer that the sample is taken so large, and that its sampling is done with such care, that each comparison (governing test) can stand by itself. If this is not done, then a number of bulk-samples would be wanted—to introduce the law of averages. I submit that the former is the more logical and the less costly way of detecting an error, except under special conditions.

It would be an impertinence in a stranger to suggest that in the well-known case of the Alaska Gastineau any precautions may have been missed by the engineers concerned. One does wonder, however, why past experience did not prevent the over-estimates that were made. Had not previous work shown that sampling results indicated higher values than were actually obtained? Was the sampling done in a way different from usual? It would be instructive to know.

Mr. Webber gives an example of his method in taking a

bulk-sample. He makes his channels 30 inches apart and strips his back one foot deep for each new face. In a letter I wrote previously I suggested a similar procedure, but taking the channels two feet apart and stripping the back two feet deep each round. It appears to me that the channels being thus placed equidistant measured both along the strike and the dip is more logical. In the case supposed (a vein or bedded deposit) presumably the reason for channeling from wall to wall is because of the structure being parallel to the walls or because values tend to form a 'grain' that way; the idea being to channel 'across the grain'. If so, I do not see why channels should be closer along one direction than along the other.

H. R. Sleeman.

Perth, Western Australia, June 28.

Copper Deposits of Lake Superior

The Editor:

Sir—On the frontispiece of the 'Engineering and Mining Journal' of August 21 was an illustration of a concrete head-frame, entitled 'The Modern Obelisk', and I noted on the right of the illustration, among the list of contents, the subject, 'Origin of the Lake Superior Copper Ores', by J. E. Spurr. I was immediately struck with the fact that the Lake Superior copper ores were also an obelisk or monument to the zeolitic type of copper deposits in basic flows, of which there are a number in the world. On reading Mr. Spurr's article, I was greatly surprised that he was going to destroy the obelisk.

I enjoyed Mr. Spurr's notes, but I do not agree with him that these deposits were formed by igneous-magmatic solutions. I would have agreed with him in 1911 when I went to the Lake Superior copper region after spending several years in districts where the mineral deposits were formed by igneous intrusives and their accompanying magmatic solutions. I propose to put a foundation under the zeolitic obelisk in the form of the suggestion that secondary concentration of very lean zeolitic copper ores by means of ascending solutions and the deposition from these solutions along certain channels formed the rich lodes.

Mr. Spurr states, "that the conglomerates and basaltic flows afford zones for the circulation of powerful ascending mineral-bearing solutions". I agree with him on this point, as I wrote a letter which was published in the 'Journal' of February or March 1919. I stated then: "That the heat given off by deep-seated portions of barren acid intrusive rocks caused circulation of solutions through the traps and assisted in the deposition and concentration of copper in the porous amygdaloid tops of the flows and in some of the conglomerates so that at present quite a few of these porous channels are ore deposits. Most all of the amygdaloidal tops of the flows even if they are slightly copper-bearing, show that there has been intense circulation of waters and a deposition of numerous minerals."

He states, "that these deposits, like many others whose origin is better demonstrated, is of igneous magma origin and that the solutions injected at a definite period contained, comparatively speaking, little sulphur or iron; that they were rich magma solutions of copper with a little arsenic, cobalt, and nickel".

My idea is that the only solutions that would be low in sulphur and form a native copper deposit would come from the Keweenawan basaltic flows erupted under submarine conditions. The volatile sulphur would easily escape, leaving minerals from which solutions with a chemical content necessary to form native copper deposits could be derived. I do not think that the fact that these ore deposits contain a slight amount of silver, arsenic, cobalt, and nickel indicates igneous magmatic solutions. Why should not these basaltic Keweenawan flows contain these metals? The sills and intrusives have been the mineralizers of silver-nickel-cobalt deposits and copper-nickel deposits in various parts of Canada adjacent to Lake Superior and it is to be expected that Keweenawan flows would contain appreciable amounts of these metals low in sulphur.

The intrusive gabbro at Mt. Bohemia, in Keweenaw county, contains small veins of chalcopyrite, bornite, and chalcocite, showing that the magma was rich in sulphur and indicating the minerals to be expected if a basic igneous magma was the mineralizer and if such solutions were injected into the Keweenawan series.

Mr. Spurr states: "That the concentration of the copper gradually from the enclosing or surrounding rocks is an explanation so evidently unreasonable and inadequate as not to merit a second thought"; and again, "It is perfectly clear therefore, that there is no special virtue in either rock—the ore is not native to either, and hence was introduced from a foreign source".

There are at least 22 conglomerates and sandstones, not including the Nonesuch formation, that are much more porous than the amygdaloidal tops of the flows, except where these show brecciation due to strike-faults. Now, if at a definite period, which would have to be after the Nonesuch formation was laid down, toward the end of the Keweenawan period, solutions lean in sulphur salts but rich in salts of copper were injected, would it not be natural for the solutions to seek the porous conglomerates and sandstones, and would there not be a number of mineralized conglomerates? As it is there are only three disclosed at present, the Calumet & Hecla, Nonesuch (foot-wall beds), and Allouez, while there are more than eight amygdaloids that contain rich copper deposits; these lodes are as follows: Kearsarge, Baltic, Quincy, Osceola, Isle Royale, Atlantic, Mass, Lake, and other lodes of less importance in Ontonagon and Keweenaw counties, which would indicate there might be a special virtue in some of these flows.

The area underlain by the Keweenawan flows is about 50 by 250 miles and most exposures show a very slight amount of native copper, with the ore deposits localized in northern Michigan and other smaller deposits at Isle Royale and Michipicoten islands in Lake Superior. There are Cambrian basaltic flows with interbedded conglomerates showing native copper associated with zeolites in northern Canada from a point west from the Copper

Mine river almost to Hudson bay covering an enormous area.

Geologists cite localities in different parts of the world where zeolitic deposits of native copper in basaltic lavas are formed and some of these are of economic importance. Is it not possible that during any cycle of the eruption of basaltic flows, probably owing to different sources of the various flows or to a segregation in the original magma, that certain flows were richer in their low-grade zeolitic copper ores than others, and that these beds are capable of having economic ore deposits formed in them?

The Lake Superior copper deposits were formed by the heat emanating from local intrusives, causing intense circulation of ascending solutions, forming a secondary concentration of rich copper ores from the original very low-grade or lean zeolitic deposits in basaltic flows. The copper remained in the flows, in which it was originally primary, with very little migration except in a few cases, which caused the formation of rich deposits.

S. S. Lang.

Houghton, Michigan, September 2.

Fume From Explosives

The Editor:

Sir—In your issue of August 28, in an article by D. Harrington and B. W. Dyer, entitled 'Danger from Explosives Fume in Metal Mining', the statement is made that frequently as much as 0.2 to 0.3% carbon monoxide is in air from piles of broken rock several hours after blasting. Ventilation has little, if any, effect on these piles, but I have found that a thorough spraying with water quickly clears them of obnoxious gases. In addition it is well to wet the faces and sides of the openings. The amount of water necessary is not great and it is removed with the broken rock. The general use of water-drills simplifies the operation; connections can be made easily, and the spraying finished in a few minutes. Where water-drills are not in use, water may be brought to the face through the compressed-air pipe. At a certain mine a sump was built at the 350-ft. station to hold the seepage. From this sump a 2-in. pipe was run to the 500-ft. station where it was connected to the compressed-air pipe and either water or compressed air was available at the face by a simple arrangement of the valves. After spraying and before connecting the hose to the drill the pipe should be cleared of water by blowing air through it. The 150-ft. head gave ample pressure at a point more than 1000 ft. from the station.

Jeffrey Schweitzer.

San Francisco, August 31.

Mining activities in the Rosario district, Brazil, while never of prime importance, show a tendency to revive after the suspension due to the War. The Corporacion Minera Famatina has sent a representative to the United States to study the equipment best suited to replace the water-jacketed furnaces at its copper smelter in Chilecito, Rioja. The company produced 733 metric tons of copper in seven months, at a financial loss, but the outlook for the future is said to be favorable and a production of 300 tons of metal per month thought possible.

The Advertiser and the Editor

A Correspondence

Pittsburgh September 31, 1920

Mining and Scientific Press,

Gentlemen:

Attention: Mr. C. T. Hutchinson, Manager.

Acknowledging your letter dated September 1st, with reference to your rate increase.

Before I discuss with you the subject of next year's contract I would like to have you tell me the editorial policy of your paper.

As you note, the sentiment of the business interests is strongly Republican, and your journal seems to represent in this editorial a distinct Democratic trend.

Two of our clients have called my attention to the above fact, and I would like very much to have an expression from you on the subject.

Yours very truly,

The A. B. Blank Co.

per A. B. Blank.

The A. B. Blank Co.

Gentlemen:

Your letter of the 31st ult. has been shown to me. As editor of the 'M. & S. P.', I regret that anything that I may have written should have hurt your feelings, but I venture to say to you that as an advertiser you have no cause to object to an article that was read with keen interest by many, as I happen to know from letters received on the subject. As a subscriber, you might reasonably refuse to read a paper that annoyed you; as a manufacturer, you might reasonably refuse to advertise in a paper that failed to give you the publicity for which you pay; but I beg to remind you that an editor's duty to advertisers is not to print what pleases them but what interests readers of his paper, with whom the advertisers expect to do business. If the article to which you object had injured the functions of the 'M. & S. P.' as a medium of publicity, you would be justified in your action; it did not; on the contrary, it helped to widen that publicity. It is certain that a large number, if not the majority, of those with whom you do business, even those of your political faith, approved the article to which you object. Our paper is independent in politics; it discusses national politics only when the subject is of commanding interest; when the election is over, you will, I trust, find nothing to annoy you, and much to interest your possible clients, in our pages.

Pending the "evolvement" of "normalcy", I am, my dear Sirs,

Yours very truly,

T. A. Rickard.

[This interesting subject is discussed on an editorial page.—Editor.]

Smelting With Bituminous Coal in Blast-Furnaces

By H. C. ROBSON

For 13 years all the blast-furnaces at the Spassky copper mine, in Siberia, have been operated with coal, for smelting the high-grade ore. As this is unusual, it may be of interest to give the details of practice. The Russian company that formerly worked the Spassky property used very small blast-furnaces in which they smelted oxidized and roasted ore to black-copper, which was then treated in a scorifying-furnace for the production of an inferior grade of refined copper.

GENERAL VIEW OF THE SMELTER YARD

When the present company, the Spassky Copper Mine, Ltd., assumed control, they attempted to make coke from the local coal, but the result was a failure, although it has been proved since then that the coal can be coked without difficulty and that a good quality of coke can be made. A typical analysis of the run-of-mine coal, as used at that time, was as follows: volatile combustible matter, 19%; fixed carbon, 52%; water, 3%; ash, 26%.

Upon the failure to produce satisfactory coke, it was decided to use coal, and a new plant was designed with much larger furnaces and a converting and refining department. For several reasons brick blast-furnaces were erected, instead of the modern water-jacketed furnace. The following points had to be considered: scarcity of water and its hardness (70°), extreme weather conditions (at times the temperature dropped to −42° C.), inferior labor, small percentage of sulphur in the charge, which would be conducive to the formation of black-copper in the furnace and settler.

The following are the chief dimensions of the three furnaces erected during the year 1907: inside length of hearth, 19.5 ft.; inside width, 4 ft.; height of tuyeres above the hearth, 18 in.; height of feed-floor above tuyeres, 11 ft. There are 32 tuyeres, 16 on each side, having an internal diameter of 2¼ in. The drawing (Fig. 1) of the original blast-furnace gives the chief dimensions, together with the general outline and design.

The hearth of the furnace is made from red brick, with tamped brasque lining; this bottom never gives trouble, as it is always covered with metallic accretions. The fire-walls of the furnace are made from unburned quartz-brick 12 in. thick. The brick superstructure, which is carried on 12-in. girders, is made from red brick on the outside and has a fire-brick lining; the whole is reinforced with cast-iron plates and bound with 6-in. I-beams. There are three charging-doors, all situated on one side, the two settlers being placed at the extreme ends of the furnace. They measure 5 ft. by 4.5 ft. by 2.66 ft. deep inside.

The charge, ore and limestone, is bedded and all return-slags are fed separately. The handling of this material was originally done in wheelbarrows, the furnace being fed by shovel. A small beam was fixed in front of each door, so that the charge had to be thrown into the fur-

RUSSIAN AND KIRGHIZ WORKMEN

nace instead of pushing it in; this promoted even distribution of the charge and diminished irregularities in the running of the furnace. The slag and matte run continuously through an open breast into cast-iron settlers, which are lined only with brick on the back side where the slag enters the settler; the rest is protected by coal-ash. Originally the slag overflowed into small pots; these were dumped by hand on a paved floor. The slag, when cool, was broken and loaded into railroad-cars, to be used for ballasting the company's light railroad or thrown over the dump. The ore that was originally smelted in the blast-furnace assayed somewhere around 20% copper, the predominating cuprous mineral being bornite, of the following composition: copper 64%, sulphur 24%, iron 12%; so it will be seen that the amount of sulphur was strictly limited and a certain amount of black-copper was bound to form during smelting operations. In later years, when the lower levels of the mine were being worked, the proportion of sulphur increased.

A most uncommon type of slag was produced; it was more like an iron blast-furnace slag than a copper one. This slag was very fluid as it flowed from the furnace, but chilled at an amazing speed. The following analyses are the yearly averages of slag from the three furnaces:

Year	Cu %	FeO %	CaO %	BaO %	Al_2O_3 %	SiO_2 %
1913		6.0	29.5	6.11	6.64	48.86
1914 .....0.42		6.77	30.1	6.1	6.4	48.5

Owing to the unvarying character of the ore and fluxes, the slag produced was uniform in composition, but the trouble caused by dirty coal was always present, being more pronounced during the winter, when the snow made sorting more difficult. The chief impurity was shale, an undesirable material to smelt even under the best circumstances, and in this plant requiring at least 33% of the flux used in smelting. With the slags mentioned, from 35 to 40% of coal was always used on the furnace charge until easier slags were produced; any attempt to reduce the amount of fuel always resulted in trouble.

The reasons for this high fuel-ratio are numerous: first, the slag produced had a high formation-temperature, the fuel was of inferior grade, the amount of oxidizable sulphur was practically nil, and, as the furnace always ran with a hot-top, a great deal of the fuel was consumed long before it reached the smelting-zone. Under the old conditions a hot-top could not have been avoided because the furnace ran so slowly. During the summer months spraying of the coal and the top of the charge with water was necessary owing to the intense heat, which was nearly unbearable for the men working on the feed-floor. The usual amount of charge smelted per day was only 80 long tons. About two hours each day was occupied in cleaning the settler of black-copper and chilled slag; during this operation it was necessary to bank the furnace. Reverberatory-settlers and numerous other modifications were tried in an effort to avoid this delay, but with little success.

The normal length of the campaign is from 9 to 16 months, when the furnace must be shut-down owing to accretions on the hearth and the frail nature of the fire-walls, which would need incessant patching to permit continued operation. The method adopted for patching the brick-work of the furnace is as follows: the thin part of the wall is broken away and the charge in the immediate vicinity is scraped out; this cavity is filled by ramming large balls of damp fire-clay into the damp clay with the aid of a pole and a sledge-hammer.

The following layers constitute the 'bed' before ironstone was introduced as a flux, the figures being given in long tons: 30 tons of limestone; 40 tons of ore; 30 tons of limestone; 40 tons of ore; and 3 tons of converter cleanings, etc. The furnace charge, containing about 11% copper, generally consisted of seven barrows, or 56 poods, of 'bed'; two barrows, or 14 poods, of converter and return-slag; and five barrows, or 25 poods, of coal. This charge was found most suitable after repeated experiments with charges of various sizes. The air to the furnaces was delivered by four Thwaites (Root) direct-acting duplex steam-driven blowers. The pressure formerly was from 8 to 12 oz. per square inch, although this pressure was increased during the latter part of 1917 to 24 ounces. After 1914 a varying percentage of ironstone was used on the charge, replacing part of the limestone; this tended to make a free-running slag and reduce the consumption of coal, but the amount of metallic copper-iron accretions increased to such an extent that it almost nullified the advantages, for the bottom of the furnace built up quicker and the settlers were kept open with difficulty. It was not until the latter part of the year 1917 that the best furnace conditions were attained. The ironstone was still further increased and the percentage of fuel cut considerably; a greater volume of high-pressure air was used, until there existed in the smelting-zone a slightly oxidized atmosphere, instead of the highly reducing one that always existed before.

Under the new conditions, as much as 4.5 tons of charge was smelted per square foot of hearth in 24 hours, with a consumption of from 17 to 20% of coal. The furnace ran with a cold top, emitting dense yellow fume of unconsumed hydro-carbons from the distillation of the coal. With the increased rate of smelting the fire-walls of the furnace soon began to show signs of burning out, but this was counteracted by side-feeding the charge, thereby forming a V-shaped channel throughout the length of furnace. In this channel the coal was placed, and trouble from that cause ceased. The top of the charge was so cool under the new conditions that it was possible to enter the furnace through the feed-doors without serious inconvenience.

Fuel was just about half that formerly used, and when it is considered that only about 50% of the coal is available for smelting, it cannot be called excessive. The tuyeres, which used to be bright, were now quite dull. The furnace operated with few irregularities, owing to the faster running and the low-formation temperature of the slag. Typical analyses of slag and matte are given below.

Slag: CuO 50%, FeO 22.5%, CaO 21.0%, BaO, 2.5%, Al_2O_3 8%, SiO_2 43.3%.

Matte: Cu 55.0%, Fe 16.8%, S 20.5%.

The following analysis is representative of the ore

coming from the lower levels of the mine, this being the type of ore smelted during the year 1917-'18:

	%		%
Cu	11.90	S	8.31
As	0.18	Al_2O_3	2.58
Sb	0.37	$BaSO_4$	11.62
Pb	0.14	SiO_2	55.48
Fe	6.28	CO_2	0.88
Zn	0.08	Bi	0.01
Ni	0.07	Ag	3 oz. 6 dwt.
CaO	0.76	Au	5 grains
MgO	0.26	Moisture	0.08

The metallic accretions produced in the furnace varied from time to time with the composition of the charge, but the following are typical:

Year	Cu %	Fe %	S %	Conditions
1913	84.33	3.5	..	Only limestone used as flux
1916	23.60	68.6	0.1	Small percentage of ironstone on the charge
1917	94.6	2.3	..	Large percentage of ironstone on the charge

problem revolves itself into one of correct regulation of the air to burn the gases efficiently under waste-heat boilers; a suitable form of closed-door charging-machine would be necessary and these have already been developed for blast-furnaces smelting iron ore. There is no reason why it should not be accomplished in matte-smelting.

The Freeland type of machine would be suitable for charging the furnace and an automatic carbon-monoxide recorder situated beyond the waste-heat boilers would be necessary to control the air for complete combustion of the waste-gases. The extra air required for complete combustion of the gases could be supplied by a low-pressure fan, driven by a variable-speed motor or steam-engine. The waste-heat boilers might be situated as near

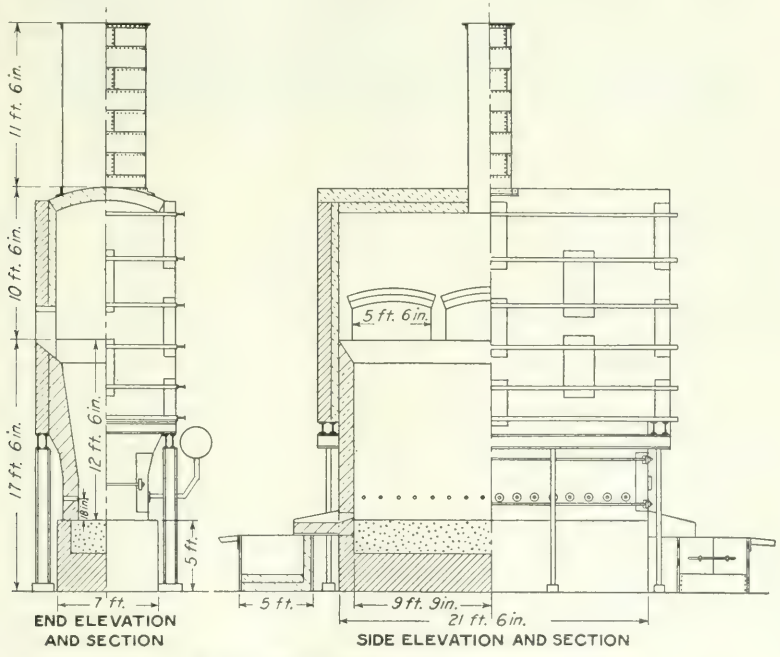


FIG. 1. THE BLAST-FURNACE USED AT SPASSKY

The following are average analyses of flux used in the blast-furnace during 1917:

Ironstone: Fe 45.34%, Al_2O_3 8.74%, CaO 2.66%, SiO_2 13.57%.

Limestone: CaO 49.3%, SiO_2 8.08%.

It is my opinion, after eight years experience with coal-run blast-furnaces, that the use of bituminous coal in matte-smelting of sulphide copper ores could be developed to a greater extent than heretofore and that it would ultimately result in marked economy over the use of coke, if suitably designed equipment were used. In carrying out the above idea I see no difficulties that cannot be overcome. The gas issuing from a furnace running on coal, with a cold top, I know from experience, is easily ignited and burns with a fierce flame. The whole as possible to the furnace and a combustion-chamber, in which the gases would be burnt before entering the boiler, should be interposed. The rapid smelting would be advantageous, since it would make a free-flowing slag and produce sufficient gas for economical operation of the waste-heat boilers.

Bedding of the charge would ensure proper mixing and small charges should be fed to the furnace at regular intervals to obtain a steady supply of gas of uniform composition.

The most suitable type of coal would contain a small amount of ash and high fixed carbon as compared with the volatile combustible material, and it should not swell on heating. The cost per unit of carbon in such a coal is less than that in coke; therefore, using coal instead of

coke in a matting-furnace with waste-heat boilers attached, all the volatile combustible material contained in the coal could be utilized to produce steam with practically no extra cost. In conclusion, I might point out that the use of coal without the inclusion of waste-heat boilers would probably be cheaper than using coke, but, owing to the explosive nature of the gases, dust could not be caught unless the gases were first burnt before being setled in dust-chambers. Without dust-catching appliances, metal losses would be high and would probably more than offset any gain.

American Capital in New Brunswick

By COLIN McKAY

The mining possibilities of New Brunswick have begun to attract American capital. The International Paper Co. has recently purchased three coal mines in the Grand Lake district, and has made plans to double their present output. The North American Antimony Co., of which Walter F. Dixon, of New York, was the principal organizer, has taken over the interests of the Canadian Antimony Co. at Lake George, and will carry on operations on a considerable scale. More recently a party of New York capitalists made an inspection of the oil-shale areas in Albert county in company with William Pugsley, the Lieutenant Governor of the Province, who is associated with parties controlling large development rights there.

Investigations made by the Canadian Department of Mines show that the oil-shale areas are sufficiently extensive to form the basis of a large industry. Average samples of oil-shale taken by the Department have yielded 60 imperial gallons of oil, or about double the average yield of the shale in Scotland, from which the distillation of oil has been carried on successfully for many years.

Among the New Yorkers who recently inspected the oil-shale areas were experts who have had to do with the development of similar deposits in Colorado, Utah, Wyoming, and Dakota. Owing to their greater richness in oil the shale of New Brunswick will, it is claimed, require a somewhat different treatment from the Scotch shale, but American experience in Colorado and Utah, where the shales have about the same content of oil as in New Brunswick, has developed retorts for the distillation of oil, which, it is said, can be utilized with advantage here.

The three coal mines in the Grand Lake district purchased by the International Paper Co. have a present output of 100 tons per day, which will be increased to 200 tons by October. This district produced only 57,000 tons of coal in 1913, but last year the output was about 250,000 tons, the principal producing companies being controlled by Sir Thomas Tait and Canadian Pacific Railway interests. The coal-seam has an average depth of 36 in. and in many parts is so near the surface that it is mined by stripping the top soil with steam-shovels. Where shaft-mining is employed the average depth at which the seam is found is 40 ft. No deep borings have been made, and the geologic formation does not argue the existence of coal-seams at great depth. Estimates of the amount of coal in this district vary from 35,000,000 to 150,000,000 tons.

During the War, and since, Grand Lake coal has been exported to Maine, and it is understood that the International Paper Co. has bought mines here for the purpose of supplying coal to its pulp-mills in Maine.

THE mine of the Climax Molybdenum Co. is situated on the south-western slope of Bartlett mountain, 5000 ft. east and 1000 ft. above the company's mill, which is at Climax, Summit county, Colorado, on the crest of the Continental Divide, and at an elevation of 11,300 ft. Climax is 15 miles from Leadville, on the South Park branch of the Colorado & Southern railroad that connects Leadville and Denver. Owing to the altitude, climatic conditions are somewhat severe for practically nine months of the year, but the topography of the country is such that there are no snowslides of any extent, and the mine buildings are so placed as to be immune from such slides as occasionally may be experienced. The mill is built on a relatively flat site remote from any danger of slides. A two-bucket tram delivers the ore to 500-ton bins, which discharge direct to a 20 by 20-in. Blake crusher, where it is crushed to 2-in. size. The ore is then delivered to a conveyor-belt, which takes it to a 400-ton storage bin at the upper terminal of the main tramway to the mill. The main tramway is a 5000-ft. Leschen continuous type, having a capacity of 1000 tons per day, and delivers the ore direct to the mill bins.

The mill was designed by D. F. Haley, and contains two Allis-Chalmers ball-mills, Callow and Janney flotation machines, Goldfield agitating-tanks for dewatering concentrates, Portland filter and steam drier, with accessory blower, pumps, and elevators. A heating plant and fire pump are housed separately. The present capacity is 350 to 400 tons per 24 hours, and the power is derived from a 13,000-volt transmission line.

MANGANESE exported from Brazil is subject to duty by the State in which it is produced, there being no federal export duties on any commodities. The State of Minas Geraes bases its export tax on manganese ore upon the official value of the product, which is fixed monthly by decree. This value, however, does not correspond exactly with the value of the ore in the market. The ratio of the tax was fixed for 1919 at 12%, and remained so until February 1, 1920, when it was reduced to 10%. The tax is payable in Brazilian paper currency. The amount of the tax for February 1920 was $1.25 per metric ton. As all the manganese ore produced by the State is at present shipped through the port of Rio de Janeiro, each metric ton of ore is subject to a port-tax, payable at the current rate of exchange in Rio de Janeiro. Bahia exported manganese ore for many years. The exploitation, however, has not been continuous, being affected principally by the value of the manganese ore abroad and the Brazilian exchange. When the Brazilian exchange is low the miner makes a reasonable profit. This State tax on manganese ore from January 1 to February 29, 1920, was $0.805 per metric ton.

THE CHANGE-HOUSE

The Bunker Hill Enterprise—XII (Continued)

The Human Side of the Business; Labor Troubles; Good Management

By T. A. RICKARD

Since 1899 there has been no strike among the Bunker Hill employees. However, at the time I was collecting information for these articles all the important mines of the Coeur d'Alene, except the Bunker Hill, were idle. That was in September 1919. A diagnosis of the disturbance appeared in 'Northwest Mining Truth', of Spokane, on September 3, 1919. It was written by Hillard W. Power. He laid the blame on the general feeling of unrest due to readjustment after the War, the willingness of the younger men to be misled by the I. W. W. (Industrial Workers of the World, a subversive organization that has succeeded the Western Federation of Miners in its rôle of trouble-maker), and disagreement between the miners and the operators as to the interpretation of the State eight-hour law. Back of these factors was the old fight of the operators for the principle of the 'open shop'. Mr. Power hinted at "the machinations of the Trust", meaning the Guggenheim smelter combination (the American Smelting & Refining Co.), as another evil influence, but for this he proffered no evidence. On the other hand, he attributed local ill feeling to the action of the owners of another mine because in the previous December they had shut-down their property for an announced period of 10 days, presumably for the Christmas holidays, and then continued the shut-down for months, much to the hardship of the men on the payroll.

The immediate issue was the claim of the miners that the shift should be measured from portal to portal, that is, the time spent in going from the portal of an adit, or other entrance of a mine to the place of work should be at the company's expense, not the miner's. For instance, on average it may take half an hour for a man, after arrival at a mine, to get to work and another half-hour to emerge from his place of work into daylight. At the Bunker Hill this loss of time is shared equally, so that the miner goes 'in' on his own time and comes 'out' on the company's. This seems fair. At the time of the strike no company was getting eight hours of work from its miners; indeed, as a matter of fact, not many of the managers knew exactly how much they were getting; in some mines the men were underground nearly ten hours and in others about nine. The lack of accurate data on the subject handicapped the representatives of most of the companies in their discussions with the Federal Mediator, whereas the manager of the Bunker Hill was able to show an accurate tabulation of the requisite figures. This grievance over time lost in going to work was the real cause of the strike, but it was followed by a demand for a blanket increase of 50 cents per day, despite the fact that an increase of 50 cents had been granted in the previous May and another increase of 50 cents on July 16; these increases had been made voluntarily by all the operators in the district in consequence of a sub-

stantial rise in the prices of lead and silver; they were not the result of any agitation or demand from the miners, they simply restored the rates obtaining prior to the cut of $1 per shift that had been made in March 1919 when the bottom dropped out of the metal market. But wages was not the real issue, so these concessions did not prevent a strike, which began on August 15. The old demand for 'recognition', of Local No. 14 International Union of Mine, Mill, and Smelter Workers Union, was presented. On August 7 such employees of the Bunker Hill as were members of this union took a vote, but as a two-thirds majority in favor of striking was not obtained, they remained at work. Shortly before, the Wardner Industrial Union, to which 300 of this company's employees belonged, voted unanimously to continue at work.

At the Bunker Hill the miners go to work on their own time and come out on the company's time. They start to go in between 7:15 a.m. and 7:30 a.m. and are at their place of work by 8 o'clock. They have half an hour for 'lunch' at noon. They quit work at 4; the last man is 'out', that is, through the portal of the adit, at 4:25 p.m. The total time within the mine ranges from 8 hr. 15 min. to 9 hr. 10 min., which includes the half-hour for refreshment at noon. The time of actual working ranges from 6 hr. 50 min. to 7 hr. 22 min., as determined by careful records. This represents the so-called 8-hour shift. At the time of my visit the following wages were paid:

$5.25 to miners
5.00 to shovelers and other common labor
5.75 to timber-men
6.25 to hoist-engineers
6.75 to shift-bosses

On February 16, 1920, in consequence of the improved metal market and the continued high cost of living, a voluntary increase of 50 cents per shift was made by the company to all its employees, and this higher rate of wages is still in effect. By way of comparison with the current scale, it may be stated that in 1896 the shift was 10 hours, the men arriving at 6:35 a.m. and leaving at 5:30 p.m., with an hour for 'lunch'; the pay was $2.50 for laborers and $3 for miners.

Nowadays when the men reach the mine in the morning they go to the change-house, where they doff their street clothes and put on their digging apparel. In the change-house they have chain-hangers, which are better than lockers. Dryers and shower-baths are provided, besides stationary wash-stands, and wash-tubs for cleaning clothes.

I saw the men coming from their work, tidy and clean, as against the dirty digging clothes in which formerly they returned home or to their boarding-houses, frequently not changing at all until going to bed. On August 5, 1919, the company issued 3000 circulars; for three days prior to the voting these were distributed not only among the employees but in the homes and business-houses of all the citizens of Kellogg, so that everyone in the community had a chance to read them before the ballot. This circular throws light upon the relations existing between the company and its employees; therefore I give it in full herewith:

TO EMPLOYEES

Some of you are shortly to vote on a movement which may have very far reaching effects and if passed on unwisely will largely curtail the industries of this community and impose great inconveniences and hardships on many who are innocently involved and who are unable to assume such burdens.

That you may determine for yourselves as to what course you will take in this movement it is thought well to place before you certain facts which have a very direct bearing on this situation and which may assist you in choosing the course which you deem best for your own interests, for the interests of your family and friends and for the community.

The industries of this community have operated continuously without cessation of any kind for over twenty years and until war conditions affected such operations they were continually expanded and increased. At all times the work was carried to maximum capacity, at no time were men laid off because of metal market conditions, and in season and out of season, without regard to profits, metal markets, stock jobbing or any other motive the properties have been worked with full crews to the advantage of its employees and the community.

During these twenty years of operation there has been a continuous and steady improvement not only in working conditions and in wages and in hours of work, but also in the community itself and in the homes of the employees, because largely of the steady employment under good conditions and the never failing large payroll.

These improved working conditions and wages were not the result of any propaganda, coercion, or threats, but a natural improvement due to the growth, expansion and prosperity of the industry. Wages paid are now and always have been higher than in any lead mining district in the United States and that means in the world and are equalled or exceeded by very few other localities known of which do not equal Kellogg as a living and working community.

The last census of employees taken before the war showed an average period of employment of four years and ten months and many employees have continued steadily for over fifteen years and some for over twenty years indicating a stability unusual in the mining industry.

This same census showed 32% of employees to be owners of their own homes. This company on January 1, last, had 81 outstanding loans to its employees a total of $46,723.85 to be repaid at the convenience of the borrowers at 6% annual interest to assist them in the purchase and building of homes. Three hundred and thirteen individual loans of this character have been made to employees in the past and in no case have forfeitures ever been taken. There are at the present time one hundred and forty eight leases on company ground to its employees and others at nominal rentals of about $1.00 per year for home building sites.

Within the last few years there has grown up at Kellogg a modern city where formerly there were but stumps and brush. This city has been built and improved by money from the mining industries of this community; few, if any, citizens drew on outside capital. The company itself has reinvested many millions in new plant extensions, in modernizing old equipment, putting up of buildings, improvements of roads, side walks, all of which are of the greatest permanent value to all and whatever profits have been taken by the stockholders during this long period of years are from funds left after every local requirement had been fully satisfied. The

above facts are laid before you that you may know that the accomplishments in Kellogg could not arise from other than good conditions, socially, financially and industrially; individually owned homes, bank deposits, automobiles, fine schools and other public buildings with ample and continuous employment for all are evidences which cannot be destroyed by any critic. We can best judge of the future by the past and with the utmost confidence can we expect continued improvement in the coming years as has been experienced in the years past provided the industries are permitted to operate fully and efficiently.

The constructive growth of the past is not the result of any sudden change or upturning, but a natural progress and evolution continually towards better things and conditions. With these facts before you it is known that your best judgment will guide you in your vote and that you will not err in choosing what is best not only for yourself but for the other citizens of this city.

Sincerely,

BUNKER HILL & SULLIVAN M. & C. CO.

Kellogg, Idaho.
August 5, 1919.

The failure of the Bunker Hill men to join the strikers caused the strike to fail; it dragged along until October 8, 1919, when it was declared off. The steadfastness of the Bunker Hill men was due to the fact that the local union at Kellogg, which is recognized by the company, refused to play into the hands of the irresponsible elements at Wallace. Moreover, the fair and humane policy established by the management, under Messrs. Bradley and Easton, has won the loyalty of the men, as it deserves to do. When I was at Spokane last September, on my way from Kellogg to San Francisco, I was interviewed by the 'Spokane-Review' and said, *inter alia*:

"The strike in the Coeur d'Alene is petering out largely because the men working at the Bunker Hill & Sullivan are showing the goodwill that has been built up by years of fair treatment and humane consideration on the part of the management toward the men. It has become fashionable to talk about welfare work and to speak benevolently about the employer to the employees, but a lot of it is insincere, and the men are quick enough to detect the insincerity, wherefore it proves ineffective as a means of creating cordial relations. At the Bunker Hill, however, an experience of twenty years has convinced the men that the consideration shown by the manager and his staff is prompted not by commercial reasons but by genuine feelings of the kind that make democracy something more than a name."

Mr. Easton is a fine figure of a man; in physique and strength he is a natural leader of men, as well as in his mental qualities. Undoubtedly an essential manhood helps to establish the authority of a manager, and when to an impressive physique are added a generous heart and a clear head, the conditions are favorable to successful management. Mr. Bradley, as president of the company, makes semi-annual visits to the property. The townspeople invariably provide some excuse for meeting him in a public manner; on such occasions he gives a friendly talk to them, besides calling upon his old-time friends, thereby tightening the bonds of goodwill between the company and the town.

Another stalwart member of the company's organization is William McDougall, who has been superintendent of the mine since 1905. He began his mining at Grass Valley, California, and has worked his way up as shift-boss, foreman, and superintendent. Mr. McDougall has entire charge of all the underground operations of the Bunker Hill and its allied companies at Kellogg, and I am informed by Mr. Easton that he has been extraordinarily successful in handling the heavy ground of the large stopes and in modifying the practice to meet changing conditions, so as to extract the ore cheaply and

William McDougall, Mine Superintendent

cleanly, but he has an unusually good record for the prevention of accidents. He is a member of the American Institute of Mining Engineers and one of the leading citizens of the community.

The character of those at the top gives the cue to the entire personnel. I noticed how courteous the members of the staff were to each other and how free apparently they were from the jangles that commonly spoil genuine co-operation. If one man asked another for information, he obtained it promptly and pleasantly, without the use, either facetiously or viciously, of loud talk or vulgar expletives, such as are only too freely used in mining districts. The members of the staff have been promoted from all kinds of lowly jobs. The manager himself went to work as a single-handed driller in November 1896. An office-boy has risen to the charge of the warehouse, a mine laborer is now chief engineer, the sampler is mill superin-

tendent, the assayer has held his present post 22 years, the cashier and office manager for 25 years. It may be suggested that there is too much in-breeding and that fresh importations might improve the stock. Dry rot is prevented by encouraging the departmental chiefs to travel and see the best practice elsewhere. Among the newest accessions to the staff is Emmett Waltman, who came back from the War with the Distinguished Service Cross, the Croix de Guerre, and the Belgian Military Cross. Before the War he was a shoveler in the mine; now he is in the survey department. He is a native of the Coeur d'Alene and won his Cross for building a foot-bridge across the Vesle while under fire. Another young soldier is Roy Hooper, who is in charge of prospecting work at the Alhambra mine of the Bunker Hill company. He was promoted to sergeant on the field of battle and suffered from shell-shock.

During the War the men were not lured away by the fanciful wages offered at the shipyards; they remained at Kellogg, where the conditions of living have been made comfortable for them. On the other hand, the company did not shut-down the mills and smelter whenever the prices of the metals (lead and silver) were so low as to justify either curtailment of output or complete cessation from production. They recognized their obligation to the community dependent upon their enterprise. The men who served in the War were re-employed as soon as they were demobilized, many of them being promoted on their return. The various services of the Government took 289 men from the company's payroll. The Honor Roll, of those who fell in battle, included 17. Their names are recorded here, for they surely constitute a part of 'The Bunker Hill Enterprise':

Lewis Newton Bailey	A. Glenn Nichols
Braxton Bigelow	Jacob Nybek
C. B. Bussell	Chester Robbins
E. N. Carroll	Hubert Everton Roberts
A. I. Hough	John Skala
Simon Iverson	George Sparenburg
I. N. Kemp	John B. Taylor
Arthur Gerald Leeson	Gus Zoellner
Roy Meyerhoff	

On the front wall of the company's office these names are inscribed upon a bronze tablet, with the following statement:

"These men, with two hundred and fifty-four others, left their work here to fight for the right in the great war of 1914-1918. This memorial is placed by their grateful friends and fellow-workers as a testimony to their sacrifice and service so gallantly and freely given that government of the people, by the people, for the people shall not perish from the earth."

Mr. and Mrs. Easton, of course, were at the head of all the war activities. Mrs. Easton was county chairman of the Red Cross, head of the War Insurance Board, and of the War Relief Work. Any woman in the community could come to her, not as the manager's wife, but as a woman, competent and sympathetic, and therefore able to give the most intelligent advice in matters personal as well as public. On a cinema screen I saw the notice: "Keep up your war insurance; don't neglect your family and future. See Mrs. S. A. Easton."

The company is wise in not running a store of its own; it operates the light and water service; it established the water-supply for its own use, but allowed the town to connect with its system and use the water at $2 per month per house, this rate being the one fixed by the State Board of Public Utilities. The company pays 60% of the school taxes, because its property is within the school district, but it never raised any objection to the erection of more schoolhouses. It may be said that the paving and lighting typify the pleasant relation between the town of Kellogg and the company, for the latter made itself responsible for the long stretch of well-paved and well-lighted avenue that extends from the bridge to the smelter.

The Bunker Hill property begins at the edge of the town, where the westward street crosses the flume. The concrete pillars of the bridge are surmounted with pieces of galena, which have been cemented in place. These pieces of ore have been chipped by boys, but enough remains to be symbolical. Along the flume near the bridge is a fence, where, I am told, "a bunch of Slavs" congregates regularly—let us hope to settle no questions nearer home than Fiume!

Among the foremen and shift-bosses are a number of Southerners, from the Carolinas and Tennessee. Most of them never saw a mine before they came to Idaho; they obtained their experience locally, but they are men of spirit and initiative, possessed of excellent judgment and always loyal. Others on the staff are Cornish and Welsh, men with mining traditions.

From the town through the Bunker Hill settlement and nearly to the smelter there extends a cement-paved highway flanked by handsome electroliers, which would do credit to any city. But this is a minor phase as compared with the houses and gardens that bespeak the comfort and thrift of the community. Beyond the mills is another cluster of houses, belonging to the smelter employees. Each house has six or eight rooms and is well equipped with modern conveniences. No two are alike; each has about an acre of ground, in which corn and potatoes are cultivated, also strawberries. Between the smelter and the mills I noticed one particularly attractive brick cottage; upon inquiry, I found that it belonged to Jim Sheridan, the chief bricklayer. When this house was built, the entire brick-laying crew worked on it gratuitously, out of goodwill to their leader, so that the building went up like a mushroom in the night. Jim Sheridan's home therefore serves as a monument to the kind of good feeling that has made the Bunker Hill something more than a hole in the ground.

The settlement as a whole, the company's part of it and the town of Kellogg, is more attractive than most mining 'camps', and above it rises ever the smoke of the smelter, like incense from the altar of industry—*pace* smoke-farmers and other disagreeable people!

When the town of Kellogg decided to establish a sewer system and found difficulty in getting money for the

purpose, the Bunker Hill company came forward and took the whole issue of bonds. To encourage education, the company gave a site, for the first schoolhouse, built it, and then deeded it to the district. The ground for the new schoolhouse likewise was provided by the company, on a 100-years lease. The Y. M. C. A. club-house was built and is owned by the company, which placed the building in the town in order to increase its assessed valuation and to render it readily accessible to the townspeople.

THE HOUSE OF ONE OF THE COMPANY'S ELECTRICIANS

The land around the mine belongs to the company, of course. Employees are encouraged to make homes for themselves. Land is leased to them at a nominal rate of $1 per annum for any area less than an acre. Then the company lends money to build or to purchase a house at 6%, although the local bank-rate ranges between 8% and 12%. The employee who borrows from the company pays monthly, with a diminution of interest as the capital obligation is reduced thereby, so that the amount paid to the company is the equivalent of a fair rent. No instance of forfeiture or foreclosure is recorded. If a householder cannot pay, the loan is transferred to an-

THE BUNKER HILL SMELTER

other employee, who takes the property with the debt, the first party receiving his equity. Some of the men have been enabled to purchase property in fee simple in the town by means of financial assistance from the company. Sometimes, instead of borrowing money, the man goes to the company's warehouse and obtains the material—lumber, brick, and hardware—which is charged against him at 6% and paid off in the manner already indicated.

Employees are insured in accordance with the State law, which fixes a scale of compensation according to the nature of the injury. Under the Act the employer pays for this insurance. Every settlement is subject to supervision by the Industrial Accident Board of the State. Even before this law was passed, the company adjusted claims without recourse to the courts and without standing on the letter of its legal liability, that is, compensation was given for injury even when it was caused by culpable carelessness. The company does not carry compensation insurance with the State nor with any company; it compensates directly out of its own revenue, the sum set aside for this purpose representing a little less than ¾ of 1%, or 0.75%, of the payroll. The men pay $1 per month and the company pays 50 cents per employee per month to the hospital. This entitles each employee not only to the treatment and care that the hospital affords but to the advice of specialists on ear, eye, nose, or throat diseases, as well as to orthopedic and other special treatment.

A big mine like the Bunker Hill serves as the nerve-centre for the surrounding region. As Mr. Easton said to me: "Lots of smaller activities hang to the coat-tails of a big mining enterprise like this." The miners accumulate a fund out of their wages during the winter and go prospecting in the summer. It must be confessed that this useful work is less popular than it was, so that many prefer to go on automobile excursions or to buy a farm. Members of the staff will take a share in a lease or small venture in the neighboring hills. The chiefs of the company or the company itself will employ members of the staff for investigations in regions far afield. While I was at Kellogg four young men returned from the Seward peninsula, in Alaska. They had been there four months, making an examination of a silver-lead prospect near Council.

We have reviewed the history of the discovery of the Bunker Hill & Sullivan group of mines; we have followed the course of the ore from the stope to the mill, from the mill to the smelter; we have watched the shipment of the refined metals to the markets of the world; we have traced the development of the enterprise from a small beginning to a big achievement; we have seen how it contributed to the growth of a model community and the impact of personal character upon human industry; it remains to suggest the influence of this mining enterprise upon the lives of men by recording a true story of one of its many thousand shareholders. When I was playing golf with a friend at Spokane on my return from Kellogg to San Francisco, my companion told me how many years ago he was in the office of a friend of his at Chicago. This friend, talking about the ups and downs of life, remarked that when everything seemed to be going wrong with him he would turn about in his chair and look up at the photograph on the wall showing the Bunker Hill mine and would then recall the fact that it had seemed likely to fail at times, yet the stock he held in the enterprise had provided for the clothing, education, and helpful start in business of his children, and the reminder gave him a fresh impulse of courage to go ahead and a renewal of confidence in the future. Such a mine as the Bunker Hill is more than a hole in the ground; it is a splendid expression of hope, initiative, energy, and accomplishment; it is the fine flower of industrial achievement.

Rock-drill steel is handled in the shop of the Champion Copper Co. as follows: The drills are received at the shop in iron baskets, those from each party of miners being ringed in separate bundles and each drill stamped with the serial number of the party. The baskets are lifted from the wagon or truck by an air-lift supported by an overhead trolley, and run onto the sorting platform. Here they are sorted and records taken showing the number returned by each party. Drills needing repairs are placed on a rack from which they go to the repair forges. The rest are placed on the rack at the heating-furnace, which is at present fired with coke, although one using oil with pyrometer control will be installed. The bits are heated to about 1900°F. the proper degree of heat being judged by color, and then go to the sharpeners. Incorporated on the sharpener is a quick-acting air-cylinder operating a long pin used to clear the hole in the steel, should this be found necessary. In sharpening, care is taken to pull out the corners that have become rounded from use. The device for doing this is a part of the fullering-die and consists of a pair of inclined planes set at an angle of 100°. Care is also taken that each operation in the sharpener is not carried too far. In other words, the bit receives a few blows from the fullering-die, then a few from the dolly; it then goes to the gauging-block, then back to the dolly or fullering-die, and so one, until the proper shape is obtained. After sharpening, the bit is tested by the gauging-ring and the drill placed on an inclined rack, which delivers it to the re-heating or hardening furnace. This was formerly a coke-furnace, but an oil-furnace with signaling pyrometer control is now used, affording an improved regulation of the heat. The importance of proper treatment of drill-steel has been emphasized more than ever by the results obtained in the all-around increase in efficiency.

A concession has been granted by the Venezuelan government to an American company for the construction of an electric railway from San Felix, on the Orinoco river, to the Guasipati goldfields of south-eastern Venezuela. The contract was signed on June 2 and is now being approved by the National Congress. The concessionaire has also made arrangements for the rental of water-power for generating hydro-electric energy from the falls of the Caroni river, situated about three miles from San Felix.

The Treatment of American Low-Grade Copper Ores

By An Australian

*The treatment of the low-grade copper deposits of the United States has as its main features high recoveries on ores containing in some cases under 5% of sulphides, high tonnages per unit-area of the mills in operation, and low working-costs. In a number of these orebodies the main mineral is chalcocite, a cuprous sulphide containing approximately 80% of copper. The principles involved in the treatment of these ores have a wide range of application, and should be of advantage in the concentration of Australian ores, although the latter are unlike in character. As this is a large subject, it can only be touched upon in a general way to demonstrate the main features of interest.

Mill Construction. Although timber construction in a mill allows more latitude for changes in flow-plan if the general scheme of concentration has not been finalized, once the best methods of treatment have been definitely ascertained, concrete and steel construction is greatly to be preferred from an operating standpoint. For this reason, although large-scale experimental plants are usually built of timber, the final construction of most of the large American mills is of steel or concrete. The advantage of this is shown among other things in the very smooth running of all types of machinery in mills of this class. In spite of the very heavy tonnages put through, mechanical break-downs are of rare occurrence. A feature of their design also is the arrangement of launders in concrete tunnels beneath the concentration floors, which allows of a cleaner and better type of mill construction.

Coarse Crushing. In most American mills dry crushing by rolls is carried to a further stage than is the case in Australia, the ore being crushed dry as fine as ¼ inch in some cases. The usual practice in large-tonnage mills is to crush initially in huge gyratory breakers of very large capacity with the usual type of grizzley at their head. At the Utah Copper Company, for instance, a single gyratory crusher is installed which will crush 1000 tons per hour with ease, large trucks of ore being dumped bodily onto the grizzley above the breaker. The ore is initially crushed to approximately 3 in., the remainder of the reduction being usually performed by rolls. The type of roll in common use differs from that used in Australia. High-speed rolls, belt-driven, with steel springs, are almost universally used. Series crushing is generally practised, the ore being usually crushed in two stages from 2½ to 3 in. mesh down to ¾ inch. Each pair of rolls is set at a definite aperture, there being no oversize return, and their crushing capacity at these coarse sizes is very high. Thus four pairs of 60-in. rolls, working two pairs in series with the other two, assisted by screens at the head of each system, will on an ore of medium hardness crush approximately 6000 tons per day under the conditions referred to above. Rotating screens are largely in use, but in this respect the Mitchell screen is a noteworthy metallurgical improvement. It is made to vibrate by a motor giving 3500 vibrations per minute. The movement of the screen itself is so small that when seeing it in use, it is difficult to realize that it is working at all, although the quiver can be distinctly felt by the hand. The efficiency is high and the construction simple. The advantages are so marked that one has only to see the screen in operation to be convinced of its merit, and it seems a matter of a short time only before other types will be displaced by it. The use of elevators between different sets of rolls is ingeniously overcome by the use of conveyors at the Utah Copper Co.'s mill, where the Mitchell screen was first developed in practice.

In considering the advantages of crushing dry to ½ inch and under, by rolls, the fact must be taken into consideration that most of the low-grade copper-ore deposits have the copper sulphides finely disseminated in the rock and require initial fine-crushing to free the recoverable mineral. With a feed dry-crushed in this way it can be more readily handled in the later stages of treatment. In the case of some ores dusting would be a great disadvantage, and where very coarse mineral can be recovered, as at Wallaroo,† by a jigging operation, it is doubtful if the advantages would be so marked. Each ore has its own grinding problems, but on American low-grade copper ores rolls have been a marked success used in series on coarse-crushing, the costs being low and mechanical troubles few. When followed by a 'one-step reduction', as it is termed, the extreme practice being at the Inspiration where the ore is crushed in ball-mills from 2-in. size to approximately 2 or 3% on 48-mesh in one operation, dry crushing has very marked advantages over any other system.

This is usually carried on till the ore is crushed to ¾ in. or ½ in. size. A dry feed of this nature can be stored conveniently in intermediate bins, making the fine-crushing and concentration sections independent of stoppages of the coarse-crushing plant. At ¾-in. size also it lends itself to accurate sampling and a convenient site for a sample-mill is between the coarse and fine systems. The main advantage is absolute control of tonnage to the concentrator, and accurate adjustment of water to ore in the ball-mills, a requirement essential to the highest crushing efficiency that can be readily maintained. The disadvantage of the system is dust, but in most ores there is sufficient moisture to check this, to a large extent, pro-

*From 'Chemical Engineering and Mining Review', Melbourne, August 5, 1920.

†In South Australia.—Editor.

vided dry-crushing is not carried to too great a degree of fineness.

Fine-Crushing Systems. From the fine-feed bins the supply of ore is usually controlled by a feeder of the Challenge type, the best method being to sectionalize the concentration department into 1000-ton per day units, each unit being provided with a feeder delivering onto a conveyor on which the fine ore is automatically weighed by a Merrick weight-meter. In a large-tonnage unit the control of feed at this point is vital in importance, as irregularities here will have a disturbing effect on the metallurgical results of the whole section, whether wet concentration or flotation is in use. A knowledge of the rate of feed at all times permits of a reduction of oil or reagents in flotation to the smallest limits, while an excellent control of conditions is possible.

Ball-Mills. Ball-mills of the best types have come to stay. Judging by the smooth running of these machines in the Miami and Inspiration mills one can say with certainty that from a mechanical standpoint practically all troubles have been eliminated, and a ball-mill of good type, if placed on sound foundations, will certainly run as well as an ordinary pebble-mill. The best practice, especially in primary-flotation systems, is to have ball-mills in closed circuit with Dorr classifiers. With this combination a very close control of crushing is possible, resulting in a more even grade of crushing than is usually the case if the ball-mill alone is used. Both the Marcy and Hardinge ball-mills are greatly in favor at present, the latter having the advantage that it can be re-lined in place and has no screens in front to wear. The cost per ton of crushing with both mills is approximately the same. The shape of the Hardinge mill allows for a very compact motor-drive. It is well designed, and its reliability from a running standpoint alone would account for its large use in America.

Milling and Flotation Practice. The tendency in the treatment of copper ores is more and more toward simplicity. The question of concentration before or after flotation has to be considered carefully in the case of each ore under investigation. Owing to the low first-cost of plant and great simplicity of the one-step reduction system followed by primary flotation, it is very doubtful if the adoption of primary concentration purely for the use of obtaining a more granular product and one more suitable for smelting than the concentrate produced by flotation is justified on an ore unless it is very coarse in texture.

Not only does primary concentration result in greatly increased cost of plant-equipment, especially at the present time, but thickening devices are necessary between the concentration and flotation plants to de-water the feed for flotation. More labor is required and the cost of treatment is higher. A few years ago lack of faith in the results likely to be obtained by flotation resulted in the erection of a primary or secondary concentration plant from a point of view of safeguarding recoveries. That time, however, has passed. The original design of a concentration plant is dependent to some extent on smelting conditions, particularly as regards the iron contents of the ore, whether the iron pyrite present in it floats or not, and whether iron is required for smelting or a high-grade copper concentrate low in iron is preferred. In some cases also primary concentration is used in the case of low-grade ores to reject a low-grade tailing and save the cost of crushing and flotation on a product below the payable limit as far as values are concerned. This is the practice of the Utah Copper Company.

Schemes at present in use embodying concentration and flotation are:

(a) Primary concentration followed by flotation.

(b) Primary concentration followed by flotation and secondary concentration.

(c) Primary flotation followed by concentration.

(d) Primary flotation followed by concentration and secondary flotation.

(e) Flotation alone.

The general tendency is toward the adoption of flotation alone, using the one-step grinding system. Wet concentration, using tables to treat the sandy portion of the flotation tailing, which is de-slimed by Drag classifiers or Dorr bowl-classifiers, results in a much simpler plant than where primary concentration is practised. No de-watering systems are necessary, and the concentration plant recovers the coarse mineral lost by flotation. This is the system practised at the Inspiration, and the factors leading to the adoption of this flow-sheet are ably summarized in the excellent paper read by Dr. Gahl in 1916 before the American Institute of Mining Engineers. Most chalcopyrite ores are particularly adapted to the simple flow-sheet of one-step grinding and primary flotation, a common practice in America being to add oil to the ball-mill and float the crushed product in Callow cells.

The main feature of water concentration on these ores is that classification is carried out to a greater extent than is usual in Australia. With an ore which in crushing produces a slime difficult to settle, experience has shown that it is essential to make a clean separation of sand and slime to get the best results by water concentration. The Deister tables are very much in favor, owing to their smooth running. The plateau effect also has marked advantages where a clean separation is desired. To economize floor-space double-deck machines have been found satisfactory. A feature of modern tables is the self-oiling head-motions, which not only ensure smooth running, but reduce repairs and attendance costs to the minimum.

As far as flotation is concerned, the bulk of the flotation problems on these ores has been solved, and the control is becoming more simple. On some properties successful results are being obtained using over 1% of oil on the ore treated. Flotation methods, however, will not be completely finalized till the cloud of litigation has passed away.

Treatment of Carbonate and Oxidized Ores. Before closing this paper a brief mention of the treatment of these ores may be of interest. Although there is no great difficulty in the flotation of carbonates by using sodium or hydrogen sulphides and thereby probably creating an artificial sulphide film on the faces of the carbonates, the trouble with most of the oxidized copper ores lies in the

fact that there are large amounts of copper, in the form of silicate, that cannot be floated in this way. In many cases there is a greater percentage of silicate than carbonate. The recent success of solution with sulphuric acid and electrolytic precipitation at Ajo has proved that this system of treatment is highly profitable, and there is little doubt that on certain ores there will be a further application of this method in the near future. For a mixed oxidized and sulphide ore the leaching of the oxidized portion first by sulphuric acid leaves the sulphides in the residue in an ideal condition for flotation, and it is probable that treatment methods will evolve along these lines.

Pumping in the Rand Mines

The impending exhaustion of many of the shallower mines on the Rand will throw a burden of increased pumping on the neighboring mines whose workings have reached lower levels. Few mines are likely to feel the effect of the cessation of pumping in the old ventures nearer the surface as much as the Village Deep, which has the old workings of the Salisbury, Jubilee, and Wemmer to its north and the declining Village Main, City and Suburban, and Ferreira Deep impinging on its boundaries. The City and Suburban may be absorbed by the City Deep and this latter company will therefore presumably be responsible for pumping arrangements in the City and Suburban. All the same it is clear that the City Deep, Village Deep, Robinson Deep, and other deep-level properties of the central section of the Rand will have to make adequate arrangements to deal with any influx of water which may find its way into their workings through the older mines which immediately adjoin the town of Johannesburg to the south. With this object in view, the design, cost, capacity, and location of a large central Rand pumping-plant is now receiving attention. Extensive work in connection with underground dams and walls is in progress at several properties in the central section of the fields. The Rand cannot be regarded as one of the wettest of the world's mining fields, but at certain periods heavy floods have drowned out the lower levels of numerous properties and the pumping-plants of individual companies have been unable to cope with the influx.

The mines, as a rule, have only sufficient pumping equipment to cope with the normal requirements. If an increased inflow is anticipated, additional arrangements are made. Consequently, if an abnormal flood occurs the lower workings of a mine are in danger of being filled more rapidly than the pumps can deal with the water, pumps are lost, the water rises in the workings, and the engines and skips have to be used for bailing water instead of hoisting rock, so that routine operations are sometimes brought to a complete standstill. Nearly every mine in the Johannesburg district suffered severely from the unusual heavy rains in February 1918, this abnormal fall coming at a time when many of the mines were already having great difficulty in coping with the water from the previous heavy rains in the latter part of 1917, and so completely overtaxed the existing pumping plants that the lower levels were flooded, and work there was suspended for some time.

The position at the Crown Mines South Rand (No. 5) shaft at this time is worth recording. The pumping plant at the main station on the 13th level, consisting of four Sulzer centrifugal pumps, of which two were intended as reserve, worked 90% of full time over a period of four weeks, handling 3,800,000 gal. per day; in addition to this, bailing had to be done both by skips and 2000-gal. bailers, the total volume of water handled per day amounting to 4,460,000 gal. The New Heriot mine on February 14 was only saved from disaster by the foresight in having had a reinforced concrete culvert constructed over the outcrop about 18 months before. This culvert was built inside an old culvert resting on the outcrop pillar, 50 ft. deep, and was carried on steel ropes extending a considerable distance north and south of the outcrop. On the principle that prevention is better than cure, the mines of the Central section are now considering co-operative arrangements which should ensure them against serious difficulties with water in the future.

An examination of the available, and in most instances official, sources of information for the principal coal-mining countries shows that the largest production per man during any year was 1134 short tons, the average production for each underground employee in the coal mines of the United States during 1918. The closest competitor of this country was New South Wales where each underground worker in 1918 produced 814 tons. British Columbia ranked third with 790 tons and Nova Scotia was fourth with 718 tons. The smallest individual output for recent years was that of Japan in 1917, where an average of 155 tons was mined by the underground employees, although in 1901 India showed an average of only 122 tons, the latter figure being the smallest during any year for the countries under consideration. During the 18-year period New South Wales and Nova Scotia have each averaged practically the same amount (718 and 715 tons, respectively). The individual output for Great Britain was until 1910 above that of Prussia, but in 1911 Prussia passed the British record and has maintained the lead since that time. France has shown but little change in the miner's yearly production, averaging 302 tons prior to the War. In Austria the annual output has averaged 296 tons per man during the past 18 years. Following Austria comes Belgium with an average of 236 tons during the 18-year period. The man-production in Belgium remained around 250 tons until 1914, when it dropped to 200 tons and showed only a slight increase during the five years of the World War. The underground workers of India have shown an almost steady increase in annual output, the quantity having risen from 122 tons in 1901 to 203 tons in 1918, averaging 178 tons during the entire period. In Japan the average output over a 17-year period was 174 tons.

Recovery Formulae

By HALLET R. ROBBINS

All ore-dressing metallurgists are familiar with the useful formulae originally derived by Jesse Scobey, for determining the indicated percentage of recovery and ratio of concentration, from the assay of the feed, concentrate, and tailing, without requiring a knowledge of the actual or relative weights of these products. These formulae are applicable to the case in which one concentrate only is made, and I do not recall having seen any similar formulae covering cases in which two or three concentrates are made. I have derived such formulae for my own use, and offer them herewith for the convenience of others.

Let

Ho = Assay of heads or feed in metal O
Hp = " " " " " " " P
Hq = " " " " " " " Q
COo = " " O concentrate " " O
COp = " " " " " " P
COq = " " " " " " Q
CPo = " " P " " " O
CPp = " " " " " " P
CPq = " " " " " " Q
CQo = " " Q " " " O
CQp = " " " " " " P
CQq = " " " " " " Q
To = " " tailing " " O
Tp = " " " " " P
Tq = " " " " " Q
Eo = Proportion of metal O recovered in O concentrate
Ep = " " " " P " " P "
Eq = " " " " Q " " Q "
Ro = Number tons ore to yield one ton O concentrate
Rp = " " " " " " " P "
Rq = " " " " " " " Q "

Then in case a single metal is saved in a single concentrate (Scobey's formulae)

$$Eo = \frac{COo\ (Ho - To)}{Ho\ (COo - To)}$$

$$Ro = \frac{COo - To}{Ho - To}$$

Where two concentrates are made, for the recovery of metals O and P respectively

$$Eo = \frac{COo}{Ho} \times \frac{(Ho - To)(CPp - Tp) - (Hp - Pp)(CPo - To)}{(COo - To)(CPp - Tp) - (COp - Tp)(CPo - To)}$$

$$Ro = \frac{COo}{HoEo}$$

$$Ep = \frac{CPp}{Hp} \times \frac{(Hp - Tp)(COo - To) - (Ho - To)(COp - Tp)}{(CPp - Tp)(COo - To) - (CPo - To)(COp - Tp)}$$

$$Rp = \frac{CPp}{HpEp}$$

Where three concentrates are made, for the recovery of metals O, P, and Q respectively

$$Eo = \frac{COo}{Ho} \times \frac{(Ho - To)(CQp - Tp) - (Hp - Tp)(CQo - To)}{(COo - To)(CQp - Tp) - (COp - Tp)(CQo - To)}$$

$$Eo = \frac{COo}{Ho} \times \frac{(Ho - To)(CQq - Tq) - (Hq - Tq)(CQo - To)}{(COo - To)(CQq - Tq) - (COq - Tq)(CQo - To)}$$

$$Ro = \frac{COo}{HoEo}$$

$$Ep = \frac{CPp}{Hp} \times \frac{(Ho - To)(CQp - Tp) - (Hp - Tp)(CQo - To)}{(CPo - To)(CQo - To) - (CPp - Tp)(CQo - To)}$$

$$Ep = \frac{CPp}{Hp} \times \frac{(Ho - To)(CQq - Tq) - (Hq - Tq)(CQo - To)}{(CPo - To)(CQq - Tq) - (CPq - Tq)(CQo - To)}$$

$$Rp = \frac{CPp}{HpEp}$$

$$Eq = \frac{CQq}{Hq} \times \frac{(Ho - To)(CPq - Tp) - (Hp - Tp)(CPo - To)}{(CQo - To)(CPp - Tp) - (CQp - Tp)(CPo - To)}$$

$$Eq = \frac{CQq}{Hq} \times \frac{(Hp - Tp)(CPq - Tq) - (Hq - Tq)(CPp - Tp)}{(CQp - Tp)(CPq - Tq) - (CQq - Tq)(CPp - Tp)}$$

$$Rq = \frac{CQq}{HqEq}$$

For a two-concentrate example of the application of the preceding formulae, the data given on page 1830, Vol. IV, of Richards' 'Ore Dressing' may be taken. These data refer to results of operations at the Lebanon plant of the Pennsylvania Steel Co. Making the proper substitutions in the formulae, the indicated recovery of the copper in the copper concentrate is 57.9% and the ratio of concentration 23.2 : 1; the indicated recovery of the iron in the iron concentrate is 87.5% and the ratio of concentration 1.54 : 1.

For a three-concentrate example, reference is made to page 923, Vol. LII, Transactions American Institute of Mining Engineers, where analyses are given of the several products obtained in the operation of the concentrator of the Timber Butte Milling Co. There are really four concentrates given in the reference cited, but making a weighted average of the coarse and fine zinc concentrates and called that a zinc concentrate, and making the proper substitutions in the formulae, the indicated recovery of copper in the copper concentrate is 4.45%, and the ratio of concentration 69.3 : 1. The indicated recovery of the lead in the lead concentrate is 22.1% and the ratio of concentration 305 : 1. The indicated recovery of zinc in the zinc concentrate is 80% and the ratio of concentration 3.46 : 1.

A comparison of indicated and actual percentages of recovery and ratios of concentration will often call attention to leaks, slops, and other mechanical losses of concentrates that otherwise might escape notice.

A DEPOSIT of magnesite that crops out on a steep hillside west of Ash creek, two miles above its junction with Gila river, about 30 miles north of Lordsburg, New Mexico, was recently examined by R. W. Stone, of the U. S. Geological Survey. The general alignment of the outcrops might indicate that it is a continuous body, 1000 to 1500 ft. long and 30 ft. thick, in limestone, but close examination shows that the limestone occurs as a number of detached blocks, none of them more than a few rods long, enclosed in granite and cut by dikes and sills of diabase older than the granite. The magnesite has replaced certain beds of limestone, but at no place has it yet proved to be 30 ft. thick, as at first indicated. At one place where the deposit has been prospected and has since caved there appears to be a total thickness of 20 to 30 ft. of magnesite and limestone. The best exposure shows only 7 ft. of magnesite in a limestone block 5 or 6 rods long, in which the beds stand vertical. The magnesite is hard, amorphous, and pure white, resembling the variety common in California.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

NEW EQUIPMENT AT THE IRON CAP AND ARIZONA COMMERCIAL.

BISBEE.—Work has commenced by the Calumet & Arizona Mining Co., on the Junction shaft, which is to be sunk approximately 500 ft. from the 1800-ft. level. It is reported that considerable water has been encountered and in the shaft alone the flow has increased from 20 inches daily to 100 inches.

Changes are being effected in the power plant; six boilers are being replaced and two additional ones added. Stacks for the new boilers will be erected shortly. It is presumed that this increase in power will be sufficient to care for all the needs of the shaft.

Work will shortly be completed on the new ventilating shaft for the Briggs division of the C. & A. mine. This shaft will provide an outlet to the surface for the smoke and gases arising from a possible outbreak of the fire in the large sulphide orebody in this division. It will be necessary to drift approximately 50 ft. from the bottom of the ventilating shaft in order to connect with the mine workings.

The Shattuck-Arizona Copper Co. has filed a petition with the State Corporation Commission seeking relief from alleged excessive switching charges. The El Paso & Southwestern Railroad Co. is named as the collector of the charges.

The output of the Shattuck-Arizona for August is given as 194,003 lb. of copper, 463,552 lb. of lead, 34,661 oz. of silver, and 406 oz. of gold.

MOHAVE DISTRICT.—Advices state that the shaft on the McCracken property at Kingman, has reached a depth of 620 ft., 220 ft. below the old level.

The United Eastern and Tom Reed mines, Oatman, are said to be operating at two-thirds capacity, all exploration work having been postponed until cool weather.

MARICOPA COUNTY.—It is reported that the old Vulture mine, 16 miles south of Wickenburg, is to be dismantled. The property has been idle for some time. During 1915 it produced 29,968 tons of gold-bearing ore, but no recent financial statement has been made.

GREENLEE COUNTY.—The Duncan Mining & Milling Co. is said to have recently found good orebodies in its development work. This company maintains its head office at Duncan, Arizona, but the mines are situated in the Steeplerock mining district of New Mexico, just across the Arizona state line. The owners of the New Year's Gift group of mines in the same district are planning the erection of a 100-ton mill.

GLOBE-MIAMI DISTRICT.—The Gibson Consolidated is reported to be working 18 men. Drifting on the 300-ft. level continues and low-grade ore-reserves are being steadily blocked out for future milling.

Construction work on the new crushing plant for the Miami Copper Co., adjoining its new No. 5 shaft, is progressing rapidly. The work will comprise 3200 yards of concrete, and it is the intention to complete it within the next few months.

A request for an increase in wages of $1 per day was recently made by the employees of the Miami Copper Co. and Inspiration Consolidated Copper Co. The demand of the employees was based on the claim that the cost of living had advanced from 80 to 150%. The request was denied on the ground that "the very adverse conditions existing at the present time in the copper industry make it impossible to consider an increase in the wage scale".

Inspiration Consolidated Copper Co.'s August output was 7,200,000 lb. against 6,500,000 lb. in July.

The Iron Cap Copper Co. is equipping its Iron Cap shaft with a complete system of fire protection. This consists of fire-doors, placed near the shaft-stations on every level, which, upon being closed, immediately isolate the shaft from the mine workings. In addition to this, water lines are placed in the shaft with sprays at regular intervals in each of the three compartments. The sprays are regulated by valves placed at the point of connection with the main water line, which is controlled by a valve on the surface, near the collar of the shaft. The fire doors at the shaft-stations are controlled by a separate compressed-air line. A small cylinder is attached to this air-line at each door and holds the door open. When an emergency arises the air in the cylinders is released by turning off the compressed air and opening the release-valve on surface. This allows the doors to close immediately. As soon as the doors are closed, the water valve is turned on and the sprays in the shaft begin to operate, thus providing an even distribution of water throughout the shaft. Should a fire occur in the shaft, the doors are immediately closed and when water is turned into the shaft it will be impossible for the smoke and gases to find their way into the mine workings and thus endanger the lives of the men.

The steel connections for the conveyor-belt which will transfer the ore from the skips of the new No. 2 shaft of the Arizona Commercial Mining Co. to the ore-bins, which have been built on the hillside some 40 ft. below the collar of the shaft, are now in place and the ore-bins are

complete. The grading of the railroad-spur is also being finished. In the course of time a number of buildings, such as timber-sheds, change-rooms, etc., will probably be erected near the new No. 2 shaft and it is believed that eventually No. 2 shaft will be the main operating shaft of the property.

PINAL COUNTY.—The Dripping Springs Copper Co., situated in the Old Flat mining district, near Winkelman, is preparing for active production and development work. The company has recently purchased the machinery and equipment of the Ray Broken Hill property, and has erected bins both at the mine and at Christmas, the shipping point. Regular shipments of ore have also been commenced.

The orebodies are on lime-diabase contacts enriched where they are intersected by the veins coming through the limestone. The two most important veins are the D and E vein. The D vein was found in the early part of this year, but it is only during the past month that the E vein has been intersected by the lower cross-cut tunnel. The total width of the D vein is reported to be 42 ft., the assays varying from 4.7 to 10% copper. The E vein was cut 520 ft. beyond and while it has not yet been explored, it is reported to show a width of about 14 ft. and contains both native copper and oxides.

NOGALES.—It is reported that the Labor Bureaus of the States of Colima, Jalisco, Nayarit (formerly Tepic), Sinaloa, and Sonora will shortly make a demand that American companies agree to defray the expenses of Mexican contract laborers from their homes in Mexico to the scene of their labor in the United States and return. According to labor statistics 23,000 laborers are wanted from the West Coast States of Mexico, by the sugar-beet, cotton, and other industries in the United States this year. In permitting these 23,000 Mexicans to enter the United States for the above purposes, the Sonoran government would, under previously prevailing conditions, assume the responsibility of returning them to their homes. If all returned to the border with insufficient money to defray their expenses back into Mexico, as between 85 and 90% are reported to have done last year, it would cost the Government approximately $26 each, or $299,000 in American money. This form of Mexican contract labor may possibly mitigate the labor shortage when the mines in Arizona again resume full production.

HAYDEN.—At a meeting in New York on September 10, the directors of the Ray Consolidated Copper Co. declared a quarterly dividend of 25c. per share, payable on September 30. This will total $394,294.75, and bring the total dividend disbursements up to $25,028,335.92.

COLORADO

APPOINTMENTS AT GOLDEN.

Cresson Gorel.—A new vein has been found in the Cresson mine 700 ft. west from the shaft at the 1600-ft. level. The vein is narrow but rich ore is reported and it is being explored. Lessees on the Damon group, [illegible] continue to mine a high-grade ore from shallow workings. Settlement on the last car was made on a basis of $135 per ton for a 30-ton lot. Upper levels of the Jerry Johnson mine adjoining the Damon have been taken under lease by local men who are searching for a continuation of the ore on that property. Drilling at the formation test in the north-east end of the district has been delayed by the drill's fitchering. The driller is fishing and is confident that he will recover his tools.

August production of the Cripple Creek district as reported from the mills and by the district representaative of the American Smelting & Refining Co. totaled 36,991 tons with an average value of $12 per ton and gross bullion value of $477,603. Of this tonnage the Golden Cycle mill at Colorado Springs handled 18,000 tons of one-ounce ore, valued at $363,000; the Independence mill of the Portland Gold Mining Co. near Victor, 18,291 tons, valued at $62,104; and the Smelter at Pueblo, 700 tons, valued at $52,500.

LEADVILLE.—Lessees in the Dinero tunnel continue shipments of high-grade silver ore, assaying from 100 to 150 oz. per ton. John Cortellini, chairman of the Bureau of Mines and Commerce, leasing on the Garbutt, has resumed operations. The mine has been idle since the walkout of miners some weeks ago. The Blaine on Yankee hill continues production of zinc ore at a rate of about 20 tons daily, that averages 25% zinc. A new plant has been erected on the Ponsardin to replace machinery destroyed by fire, and production has been resumed. A shortage of ore-haulers in the district is causing accumulation of tonnage at many leased properties.

BOULDER.—Increased forces are working on the Caribou and other properties and the output for the month will show considerable increase. The White Raven is shipping steadily and plans to continue operations through the winter. The Yellow Pine, under lease to E. B. Hill and Boulder associates, is active. The lessees are sinking 900 ft. J. W. Pherson, another Yellow Pine lessee, is producing and shipping a good grade of ore. The new mill at the Blue Bird is nearing completion. Ore-reserves are being developed for the mill. The Boulder sampler is operating at capacity.

KOKOMO.—A permanent camp has been established at the Pearl group and supplies sent in to keep the mine in operation during the winter have been sent forward from Denver by the Kokomo Mining Co. for use at the Chalk Mountain property.

TELLURIDE.—August shipments from the Telluride mills were 60 cars from the Tomboy and 35 cars from the Smuggler mines of the Smuggler-Union. Progress is being made on the construction of the new plant at the Smuggler.

DENVER.—The Board of Trustees of the State School of Mines at Golden have appointed Harold W. Gardner, of the University of Illinois, professor of civil engineering; G. W. Gorel, a graduate of Wesleyan, professor of mathematics; W. P. Hale, formerly head of the department of mathematics at Broaddus College, West Virginia, assistant professor of mathematics; L. D. Roberts, assistant professor of chemistry.

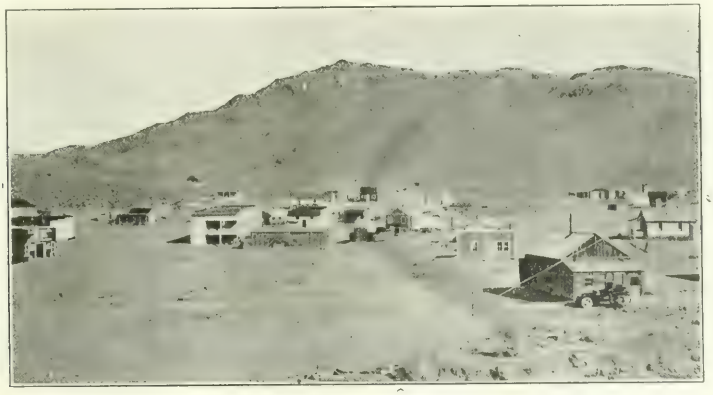
MICHIGAN

REDUCED COPPER STOCKS.

CALUMET.—Calumet & Hecla has completed shipment of the 2200 tons of copper ordered by French concerns several months ago, the final shipment consisting of 2,400,000 lb. The entire order called for wire-bars and billets, all special shapes that required additional time. This practically completes the unfilled orders at the Calumet smelters and for some time, perhaps thirty days, metal will accumulate on the docks. A small shipment of 100,000 lb. went to Detroit last week from the Calumet docks. This is one of the new orders booked by C. & H. for the Michigan metropolis this year. Calumet's Detroit business for twelve months, in fact since the Armistice was signed, has been negligible compared with war orders and even less than pre-war sales. Calumet's surplus on the Hubbell docks and in process of refining aggregates 7,000,000 lb. and there is still close to 13,000,000 lb. of refined copper on the docks of the old Tamarack-Osceola smelter at Dollar Bay. The total, 20,000,000 lb., reflects a material improvement in the metal situation since the first of the year when Calumet & Hecla alone reported upward of 32,000,000 lb. on hand. The surplus at the Calumet docks represents the metal on hand of all subsidiaries as well as the parent company so large reductions in the stocks of all companies have occurred. Smelter-men, whose observations of conditions invariably serve as a barometer of the metal trade, are optimistic in their views of the immediate future and they forecast a material improvement early in October. The fact that Calumet's smelters are operating at capacity, with all furnaces in commission, seems to bear out this prediction and there is a better feeling in evidence throughout the Lake district.

'Rock' tonnages for the Calumet mines for August show small changes, compared with July, save for Ahmeek which shows an improvement. During the month, Ahmeek reported approximately 71,350 tons against 68,068 in the preceding month. The old Osceola shows a decrease of about 2800 tons, reporting 8100 for August against 10,125 in July. This reflects the recent transfer of 25 men to the Calumet Osceola shafts. Kearsarge dropped slightly in August, with a 'rock' tonnage of 39,572 against 40,715 in July. Allouez cleaned up the remainder of the 'rock' that was broken down in the stopes when the mine suspended, and its shipments for August aggregated 1000 tons. Superior reports 1520 tons for August, an increase of 400 tons over July. There were no overflow shipments from Isle Royale, the production being barely sufficient to keep its own mill in operation.

Calumet & Hecla is using a stope-scraper to advantage and there is a likelihood that more of the same type will be introduced. The scrapers are in use on the 75th level of No. 7 shaft and also in No. 10 and in the Red Jacket shafts. Operated by three men, the scraper handles 40 cars of rock on a shift, against nine or ten cars filled by hand-tramming by two men during the same length of time. The unusual performance of 40 cars on a shift for the scraper comes only in cutting out the stopes. The mechanical 'mucker' in use in the haulage tunnel is an assured success for, operated by four men, it fills from 16 to 18 cars on a shift, or as much as eight men could fill by hand shoveling.



GOLD HILL, UTAH

The Tamarack and North Tamarack reservoirs are being drained in the hope of reducing the flow of water into the mines. Both contain a large amount of water and it is likely that much of the surface water that seeps into the lower workings comes from them.

The old Tamarack mill is practically dismantled and about 50% of the equipment has been moved from the site. The razing of the plant is proceeding at a rate that indicates it will be possible to begin work on the reclamation-plant foundations before early winter and steel erection can be commenced in the spring. Under favorable conditions it should be possible to turn out mineral by the early part of 1922.

Wolverine is installing an electric pump at the old Wolverine mill dam which was in use when the stamping plant was built near the mine. The water has been

seeping down into the mine, adding to the difficulty of keeping the mine free from water. With this flow cared for, Wolverine will have to pump only its normal accumulation of water and both shafts will be permanently free for 'rock'-hoisting continually. Considerable interest has been aroused locally over the plan of Wolverine to develop additional lodes on the 28th and 13th levels and there is a hope that valuable ground will be opened. The section on the 28th level is in the foot-wall and the 13th involves explorations in the hanging. Several veins penetrated in cross-cutting the property have shown up well and while the openings were not rich in copper there was sufficient mineralization to warrant extensive developments before giving up the mine. The 13th-level objective is the Kearsarge conglomerate, of which comparatively little is known from developments in late years but the old Ahmeek found this lode exceedingly rich. It is this vein that Seneca tapped by a diamond-drill last spring, but in the section from which the cores were taken the mineralization was somewhat disappointing. Seneca's disclosures, however, by no means indicate that there is no copper in the vein elsewhere. Both Wolverine and Mohawk are producing about 70% of normal, with the former hoisting from 800 to 900 tons per day and Mohawk, 1400 to 1700 tons. Wolverine's yield for the past few months has been in the neighborhood of 17 lb. while Mohawk holds persistently to 23 lb. to the ton. Wolverine 'rock' still is being stamped in the Mohawk mill and this arrangement likely will continue until greater output is required. The concentration of operations in the one mill makes for a marked saving of fuel and at the same time affords opportunity to make necessary changes and repairs in the Wolverine mill. The new pumping plant, owned jointly by the two companies, is operating successfully and economically. It means a considerable saving in fuel, because it is operated by exhaust steam that has hitherto been wasted. The project will have paid for itself within a few years even on a reduced operating basis. Considerable power can be generated by the turbine in excess of present needs and this will be utilized later by the re-grinding units which it is proposed to install when conditions justify additional expenditures. Both Mohawk and Wolverine are well sold up and there is little of any metal on hand. Chicago, Detroit, Kenosha, and other cities are consuming Stanton copper readily, so these mines are free from the worry of carrying over large stocks. Approximately 30% of the normal supply of coal has been received by Wolverine and Mohawk, although on the present operating basis not more than 50,000 tons will be needed by both plants for the winter.

Seneca reports a material improvement in the third level, north, at a point 816 ft. from the shaft, while good ore is still found in the fourth, 558 ft. from the shaft. In the south drift of the fourth level progress has been retarded because of the labor shortage and it will be some time before the Ahmeek boundary is reached. Altogether, Seneca is operating eight machines, two of which are used in sinking and the remainder are in the drifts.

NEVADA

MINERS STRIKE AT VIRGINIA CITY.

DIVIDE.—The Tonopah Divide shaft has been completed to 1000 ft. and cutting of a station at this depth has been nearly finished. On completion of the station a cross-cut will be driven to the vein, estimated to be 130 to 140 ft. distant. Judging from the rake of the ore-shoots on the 585-ft. level men familiar with the mine think it will be after November 1 when the shoot is entered at 1000 ft. The cross-cut to the vein at 800 ft. has been driven 25 ft. from the station. The plan of the management is to have the cross-cuts at 800 and 1000 ft. reach the vein simultaneously and, while it is regarded as probable that drifts will have to be driven south-east to open ore, they may have to be driven only a short distance, or ore may be found in the cross-cuts, as the shoots north-west of the shaft on the upper levels may at 800 and 1000 ft. be where the cross-cuts will enter them. The Victory winze is nearing 500 ft., where lateral work will be done. This winze is almost vertical and, depending on the grade and quantity of ore found, it may be extended to the surface and used as the main shaft.

VIRGINIA CITY.—The miners are on strike for an increase of $1 per day to the present wage of $5. Only enough men to keep the mines clear of water are working instead of the 350 to 400 formerly employed. The men at first voted to remain out until the increase had been granted, but later when representatives of the operators and miners met with Governor Boyle a committee of two, Edward Higgins, consulting engineer for the Gold Canyon Dredging Co., representing the operators, and Frank W. Ingram, the miners, was appointed to investigate wages and costs in Virginia City as compared with other districts in the State. The operators, in a statement, said the action of the miners was taken despite several contracts, some effective to January 1, 1921, and all of which call for 30 days notice to the operators before being nullified. The statement said: "In view of the absolute proof that the cost of living has already decreased, and will continue to decrease, we do not feel that a raise in wages is at all warranted at this time. We are ready and willing to resume operations under the old scale of wages. None of the organizations represented by the operators is opposed to unionism on the Comstock." The operators do not regard their statement as a refusal to grant an increase and it is thought this may be the result of the negotiations if the committee favors it.

DAYTON.—The 900-ton all-steel dredge of the Gold Canyon Dredging Co. was started on Sunday, September 4, by Mrs. Emmet D. Boyle, wife of Governor Boyle, with the Governor and other State officials present. Among the speakers were the Governor, Walter E. Clark, president of the university of Nevada; Dr. Aurelia Rhinehart, president of Mills college, Oakland, California; Edward Higgins, consulting engineer for the company; and R. H. Elliott, assistant general manager. The starting of the dredge was witnessed by 1500 people from Reno, Carson, and Virginia City and it was a big day in the history of the little town of Dayton. The consulting engineer said

the construction had been completed in four months actual working time. He explained that, because of the uneven surface of the bedrock, large boulders in the gravel, and high costs, the conditions under which the company would operate were not ideal. The dredge cost $350,000 and it is estimated that the daily cost of operation will be $400. Twenty men will be employed in three shifts at first, but this force will be reduced quickly to three to five men on a shift.

CARSON.—A high State official, when asked how Governor Boyle's name came to be associated with the Broken Hills, said the Governor inspected the workings and gave an opinion without knowing that George Graham Rice would promote a company to take over and develop the claims. The official said the Governor was angry when he saw his name linked with that of Rice, but that he was in a position in which he could do nothing. The official said he was surprised at seeing the name of Edward Malley, State Treasurer, appearing at the top of Broken Hills stationery and declared he did not know how Malley came to be connected with Rice or why he should permit his name to be used. He also predicted that "there will, of course, be a smash-up one of these days". Conservative mining men regard with regret the entire Broken Hills affair, as they consider the name of Rice again connected with Nevada can result only in injury to the State. The name of Boyle and Malley connected with the promotion of the company with no explanation from either remains a mystery to their friends. Men who say they are familiar with recent work in the mine do not regard the result as being worthy of the columns of publicity being given Broken Hills in Nevada newspapers as 'boost' material, accompanying large advertisements in which the reader is sometimes reminded that Goldfield Mohawk stock went to $20 per share.

GOLDFIELD.—The winze being sunk from the 910-ft. level of the Spearhead is 200 ft. deep and it will be continued to at least 500, according to R. S. Wilbur, superintendent. The winze, being sunk on an incline of 76°, is in a series of step-faults and it is penetrating quartz and alaskite alternately. It is now on the hanging-wall side of the vein and a cross-cut is to be driven to the foot-wall. Assays of $5 to $6 are being secured. The Five to One tunnel has entered the vein that had been the objective of the work started last October. The vein was entered on the foot-wall side and the tunnel has been driven into it for 3 ft. Ore was not found and drifts will be driven after the hanging wall has been reached. The vein is composed of talc and quartz.

TULE CANYON.—The Silver Hills has announced that leases will be let on the Jaggers claims, adjoining the Ingalls group on the west. There are several shafts in this territory that are from 50 to 100 ft. deep and there is low-grade ore in them. The company will mill the ore from the leases.

PIOCHE.—From January 1 to September of the present year, the Prince Consolidated Mining & Smelting Corporation has produced 36,152 tons of ore. At the present time shipments are running about 5000 tons per month.

CAMP AT THE MANDALAY MINE, JUNGO, NEVADA

The ore is of the usual grade, 75% of the total tonnage being derived from the Davison bed and the remainder from the Prince bed. Arrangements will shortly be completed for the resumption of the sinking of the main shaft to the lower bed.

Shipments from this district for the week ending September 7 totaled 3240 tons, of which amount the Prince Consolidated shipped 1900 tons; Virginia Louise, 800; Black Metals, 100; Bristol Mines, 250; Combined Metals, 150; Consolidated Nevada-Utah, 40.

ELY.—The directors of the Nevada Consolidated Copper Co. held their regular quarterly meeting in New York on September 10 and declared a dividend of 25c. per share, payable September 30. This will call for a total distribution of $499,864.25, and bring the grand total up to $46,768,616.60.

JUNGO.—The Mandalay Mines Co. has completed the erection of an 8 by 10-in. air-compressor, 15-hp. gas-engine, 6-hp. gas-engine, hoist, air-blower for the mine, sinking-pump, and other equipment to complete the plant. The shaft, 4 by 6 ft. in the clear, is to be sunk under contract to 120 ft. from the present depth of 80. A depth of 500 to 600 ft. can be reached with the equipment and

it is planned to reach this depth eventually, with drifts at 100-ft. intervals. The machinery has been bought and the shaft sunk to 80 ft. at a cost of less than $14,000. The shaft is in ore containing silver glance that assays from $20 to $75 per ton, with a high silica content which keeps the treatment charge under $1.50 per ton, according to the management. The shaft is nearly vertical. Part of a 35-ton shipment of $35 sorted ore has been hauled to the station at Antelope and shipments are to be resumed when the 100-ft. level is reached. Work was started July 20, 1919, but little was done except build a camp and improve the roads to Jungo, Sulphur, and Antelope before cold weather. The spring and summer has been devoted largely to putting the machinery in place. The State engineer has given the company permission to use ½ second feet of water. This gives possession of Mandalay creek and Dwyer springs, the latter on a mill-site which the company plans to utilize for the erection of a mill when mine conditions make a plant advisable. Water is pumped also from a 30-ft. well for household use. The amount of cash spent by the company has been lessened by the employees taking stock in part payment of their wages.

Eureka.—The Mammoth Mining Co. is now shipping two carloads per day from its mill-dump to one of the Salt Lake valley smelters. The dump contains about 250,000 tons of material, which will average $7 per ton in metal content. By use of a small engine and mine cars, the material is transported from the dump to the loading-station a short distance away; horses and scrapers being used to fill the smaller cars. The average cost of loading the material is about 35 cents per ton. Earl McIntyre, manager of the Mammoth property, states that from two to three carloads of ore per day is being mined. The company is doing considerable development work, the most important of which is the drift to the north-east on the 1500-ft. level. Another piece of development is being performed on the 300-ft. level

NEW MEXICO

Hurley.—The directors of the Chino Copper Co. declared a quarterly dividend of 37½c. per share on September 10, payable September 30. This will call for a payment of $826,242.50, and will bring the grand total of such disbursements up to $29,991,709.50.

UTAH

ORE SHIPMENTS TO THE SMELTER. ACTIVITY AT OPHIR HILL CONSOLIDATED.

Salt Lake City.—At a meeting of the directors of the Utah Copper Co. in New York on September 10, the regular quarterly dividend of $1.50 per share was declared, payable September 30. This will call for the payment of $2,436,735, and will bring the grand total of such disbursements up to $100,072,927.50.

During the week ending September 4, the sampling mill of the Utah Ore Sampling Co. at Murray handled 82 carloads of ore from Utah mines, 6 from Nevada; 4 from Montana; 2 from California; 1 from Idaho; and 1 from Canada. The Tintic mill of the same company handled a total of 88 cars of ore from Utah mines.

Marysvale.—The Tushar Range Metals Mining Co., a Pittsburgh organization, after two years of persistent development at its property here, recently made one of the most important ore discoveries in south-central Utah. Guided by geological conditions, the company drove a tunnel into the south wall of Pine canyon a distance of nearly 500 ft., and entered a lead-bearing bed of calcite, which was followed more than 200 ft. through primary lead, silver, and gold ore. At 795 ft. the company is sinking an incline winze, with the object of reaching the underlying quartzite. Officials state that each foot of depth is marked with improvement in the lead content and the size of the lenses of high-grade ore. The orebody, which has now been proved to be more than 30 ft. thick, will doubtless exceed 50 ft. before the quartzite-calcite contact is encountered.

Park City.—An assessment of one-quarter of a cent has been levied on the capital stock of the Daly-Judge Extension Mining Co., payable September 25. The money derived from the assessment will be used to develop the property.

During the week ending September 4, eight mines in this district shipped a total of 2186 tons, as compared with shipments aggregating 2157 tons for the preceding week. The Ontario shipped 600 tons; Silver King Coalition, 582; Judge M. & S., 495; Daly-West, 239; Nail-driver, 110; Keystone, 55; Daly, 53; Park-Utah, 52.

Big Cottonwood Canyon.—Development work at the Woodlawn mine is being steadily done under favorable conditions, according to W. J. Lawrence, the manager. Upon the lowest level, at a vertical depth of 600 ft., drifting has been carried forward a distance of 200 ft. westerly from the point at which the cross-cut from the winze from the main tunnel-level cut the fissure. Ore was found for the entire distance in this drift. A raise from the 600-ft. level to the main tunnel-level, 100 ft. above, is following good ore. This raise will also improve the ventilation. On the main tunnel-level, in the west drift, along the fissure, a raise is being made. It has reached a height of 80 ft. and there is 3 ft. of good ore showing. Ore is now being hauled from the mine to the loading bins in the canyon.

Ophir.—The policy of the mining companies in this district is never to release much news concerning their activities. Nevertheless, development work of great interest and value is steadily being done. Most of the mines are more or less privately owned, and there is a lack of technical literature describing geological features. The largest property in camp is that of the Ophir Hill Consolidated, owned by former Senator W. A. Clark of Montana. This mine has a gross yield of between 35 and 40 million dollars to its credit, and at present, according to a conservative estimate, it is producing metal to the value of $800,000 per annum. It is said that the management is planning to remodel its concentrator along up-to-date lines to improve its efficiency. The property at present is

shipping an average of two carloads of concentrate per day and one car of ore.

It is reported that the Ophir Silver Mines Co. has made a strike of excellent ore on the surface in the Buckhorn fissure. A force of men has been put to work at this place and a camp established.

At the mine of the Ophir Metals Co., a force of 30 men is employed in driving the tunnel, which is 1200 ft. from the portal. It should reach the old Lion Hill workings, from which some 3 million dollars' worth of ore was shipped. At a distance of 800 ft. from the portal, the Buckhorn limestone should be entered. In this it is expected that the same orebodies will be found in the fissure as were encountered in the Treasure Hill bed, some 500 ft. above.

TINTIC.—Shipments from this district for the week ending September 4 totaled 145 cars, an increase of 4 cars over the previous week. The Chief Consolidated shipped 40 cars; Tintic Standard, 30; Eagle & Blue Bell, 10; Dragon, 10; Mammoth, 10; Iron Blossom, 8; Grand Central, 8; Iron King, 5; Bullion Beck, 4; Swansea, 4; Gemini, 3; Victoria, 3; Gold Chain, 2; Colorado, 2; Centennial-Eureka, 1; Griggs Huish Leasing Co., 1 car of concentrate.

Recent developments at the Plutus property, controlled by the Fitch interests, have been most encouraging, according to Cecil Fitch, manager. Recently a drift on the 1700-ft. level cut a few small stringers of quartz and talc, and assays showed 3 to 4 oz. of silver and 0.15 oz. gold per ton, which the officials believe indicates the close proximity of an orebody. Mr. Fitch states the drift will be extended until it cuts the fault-zone, and that later the company will do some additional prospecting at points where the best showings exist.

About 125 men are now employed in the construction of the Tintic Standard company's concentrating plant at Warm Creek. Two electric hoists are used for lifting materials to the proper elevation on the hillside. The boarding and lodging houses, warehouse, office building, machine and carpenter shops, and dwellings for employees have been completed. A 44,000-volt sub-station, two miles of 2300-volt line, and five banks of service transformers have also been installed. Some of the last construction is of a temporary nature and will be replaced later with a permanent installation. A contract has been awarded for the construction of an 11,000-volt powerline from the Tintic Standard to the site of the South Standard company's new shaft, a distance of two miles. The sinking of the shaft at the South Standard has reached the point where a hoist is needed, and the company is planning the installation of a modern hoist and compressor, both to be electrically driven. During the past few months, the company has erected the necessary surface buildings, and when the hoist and compressor are installed, development work will be undertaken in earnest. The South Standard is controlled by the same interests as the Tintic Standard.

BRITISH COLUMBIA

EXPLORATION AND DEVELOPMENT IS GENERAL.—DOLLY VARDEN AGAIN SHIPPING.

ALICE ARM.—The Dolly Varden railway is operating at capacity again. Notwithstanding the washouts, 4500 tons of ore was shipped from the mine to the Granby smelter, at Anyox, besides a small quantity of high-grade, which was shipped to the Tacoma smelter, as the Granby company does not care to handle this class of ore. In July 5600 tons of ore was shipped over the line. About 115 men are employed in the mine and a like number on the railway and in construction work. Work on the 500-hp. hydro-electric plant, at Clearwater lake, is progressing well. W. R. Ross has bonded the Moose mine to D. W. Cameron and associates for $165,000. The same parties have made an examination of the Esperanza group, with a view to purchase. Some high-grade silver ore has been taken from surface operations on this property recently and a small shipment is being sent to the Tacoma smelter. Wolverton, Hammond & Bruggy have started work on the extension of the Silver Tip vein.

TAILING DUMP AT CORTEZ MINE, EUREKA COUNTY, NEVADA

YMIR.—John W. Shaw, who is superintending development work at the Texas Yankee Girl mine for the Mining Corporation of Canada, reports that the mine is developing well. Two 300-ft. raises have been made from the No. 5 level, and will be continued another 400 ft. to connect with No. 2 level. This work together with that on the intervening levels will block out a large body of ore. The raises have been driven on the vein, and are in good ore.

Nelson. The Perrier mine, situated on Cottonwood creek on the slope of Morning mountain close to the line of the Great Northern railway, was recently taken over by a re-organized company with a capital of $250,000 and the officers of which are C. E. Crossley, president; R. W. Hinton, vice-president; W. M. Cunliffe, secretary-treasurer. It was discovered in 1910 and named from the late King Edward's famous horse. Mr. Turner is one of the original discoverers. The main shaft of the mine has been sunk 120 ft. The present plant consists of a Huntington three-foot mill of five-ton capacity for treating ore from the drift. From this mill $3300 in gold has been taken, other metals not having been recovered. There also are a Rand drill, a Rand hammer-stoper, and a three-drill Rand compressor driven by a Pelton wheel. There is an abundance of water and Messrs. Crossley and Turner claim they have invented an automatic pump to keep the mine free from water which will work for 12 months without attention. It is planned to put in a stamp-mill and a modern hoist. About 80% of the ore is free-milling.

A second vein has been discovered by surface stripping on the property of the Mountain Chief copper mine, Renata, on the lower Arrow lake. A tunnel has been driven exposing considerable mineralization, the ore, for the most part, being oxidized.

A new vein is reported on the Barnet Silver-Lead group at the head of Lemon creek. The new lode is similar and runs parallel to that on which work has been done. Already ore from this source is being sacked for shipment. The Barnett mine was re-opened by R. G. McLeod some four or five weeks ago. It has been a shipper in past years.

Trail.—A total of 11,257 tons of ore and concentrate was received at the smelter during the last ten days of August; the Consolidated company's mines supplying 9854 tons. The other shippers were: Bluebell, Riondell, 156 tons; Canada Copper Corporation, Greenwood, 11; Iron Mask, Kamloops, 83; Josie, Rossland, 296; Mandy, Le Pas, 372; Mayo, Yukon, 3; Monarch, Field, 37; North Star, Kimberley, 251; Providence, Greenwood, 72; Sally, Beaverdell, 45; Silver Standard, New Hazelton, 41; Skylark, Greenwood, 16; and Venus, Carcross, Yukon, 20. Up to date this year, the Mandy mine, at Le Pas, has shipped more than 7000 tons to Trail.

Stewart.—It is reported that the present bond holders of the Big Missouri group of mineral claims, Salmon River, Portland Canal district, do not intend to continue development work. Operations have been under way for some time by a syndicate known as the Pacific Coast Exploration Co. prominently identified with which is Sir Donald Mann, of Toronto. Both diamond-drills, with which exploration work has been in progress, have been withdrawn. The only information made public, and it is unofficial, is that the Big Missouri presents an unusual problem, that the small amount of drilling done has not given satisfactory results, and that the complete exploration of the entire mineralized zone is a work of such magnitude that the company does not feel disposed to continue at present.

ONTARIO

RECENT DEVELOPMENTS AT KIRKLAND LAKE.

Toronto.—At a special meeting of the shareholders of the Dome Mines Co. on September 7 the proposal of the directors to purchase the property of the Dome Extension Co. was unanimously ratified. The Dome Extension shareholders will receive 76,667 shares of Dome stock, being one share of Dome for every 30 shares of Dome Extension.

The arrangements made by the Davidson Consolidated in England, by which $1,125,000 will be secured for development and the construction of the mill, is opposed by some of the shareholders, who object to optioning 50% of their stock to the English interests, which will prevent them from taking advantage of a favorable market to dispose of it. G. C. Crean, president, has issued an explanatory statement recapitulating the terms of the agreement under which, in addition to the 1,500,000 shares of treasury stock to be sold outright, the English syndicate requires a two-year option on 2,000,000 shares now held by shareholders the exercise of which would give them a controlling interest. To meet this demand each shareholder must option 50% of his stock, otherwise the deal will fall through and the company will have no other alternative than to assess the shareholders to provide the funds required to build the mill and carry on development.

A diamond-drill machine is being taken to the Clifton, where exploration will be undertaken to determine the extent of the continuation of orebodies already found.

Kirkland Lake.—The development of the new eastern portion of the Kirkland Lake field is attracting much attention, the results of operations so far having been of a decidedly encouraging character. Promising features of this section are the great width of some of the veins opened up, and the existence of veins containing visible gold as well as gold tellurides in close proximity to contacts between conglomerate and porphyry. This is a condition almost identical with that shown on the surface in the proved part of the Kirkland Lake area. The Bidgood, Wood-Kirkland, Crystal Lake, Pinelle Kirkland, King Kirkland, Lebel Ore, and others on which development has recently been begun, are all located on the main belt of favorable rock formation extending eastward from the producing area.

Boston Creek.—It is stated that visible gold and gold tellurides have been encountered at the Miller Independence at a depth of 500 ft., the orebody being apparently the downward continuation of the rich ore-shoot developed in the upper levels of an inclined shaft. This work was only carried to a depth of 200 ft. The Patricia has been optioned at a high figure to T. J. Flynn.

Cobalt.—New equipment is being installed at the Kerr Lake to handle a large tonnage of low-grade ore on the dumps. It includes a mechanical shovel, automatic loader, and crushing machinery. The ore will be shipped by aerial tram to the Dominion Reduction Co. for treatment. Production is being maintained at about 50,000 oz. of silver every three months.

CALIFORNIA

Amador County.—The Central Eureka at Sutter Creek has been sinking in pay-ore from the 3100-ft. level for several weeks. It is a new find, and although the area is unknown the prospects are so good that the company is planning an underground hoist for next year. The surface plant has about reached its limit. The result of the conferences in San Francisco between representatives of the Argonaut and Kennedy companies has not been made public and the situation is unchanged. New pumping machinery has been added to the South Eureka mining plant, which is connected with, and drains the water from, the Central Eureka.——After months of work, the restraining dam constructed by the Crocker Estate company of San Francisco for the purpose of impounding tailing from the Elephant hydraulic mine, is completed. It is 30 ft. high and 425 ft. long. Washing is expected to commence on November 1.

Bakersfield.—The California Rand silver mine, in the eastern part of Kern county, has $2,000,000 in ore in sight, and is paying $25,000 monthly dividends to its stockholders, mostly in Bakersfield, Taft, and Fellows, according to reports received here. The California Rand property, which is the biggest producer in this section since the days of the Yellow Aster, has been producing for two years, and the ore is said to run as high as $50 per ton. J. W. Kelly and Hamp Williams discovered the California Rand mine, and Kelly recently sold his interest to E. L. Blanck of Fellows for $200,000. Blanck also bought the John Nosser interest for $80,000. Two years ago one-eighth interest in the mine sold for $500.

Calaveras County.—Exploration work is general and all available men are busy. Outterbidge and Howe are re-opening the Smith mine, formerly known as the Ketz. They employ 17 men and are driving a 900-ft. tunnel with the object of working the vein 1100 ft. below the outcrop. George Prentiss is developing a prospect on the North Fork of the Mokelumne. He has driven 60 ft. on a 4-ft. vein of $50 ore. The West Point Gold company is commencing work with 20 men on some low-grade properties on Licking Fork. The North Star has taken over the Defender and Lone Star groups and will spend $500,000 in sinking.

Imperial County.—Baverstock & Staples report that litigation over the Paymaster and President mines is nearly at an end. The Anaheim M. & M. Co. is preparing to treat the old tailing and re-open the old workings.

Nevada County.—Repairing the New York Hill and other shafts of the North Star is proceeding. The new electric engine to take the place of mules underground has arrived. At the Idaho-Maryland the water in the incline Canyon shaft at the bottom of the 1100-ft. shaft, is being kept at a standstill. The Alcalde continues to produce rich specimen ore from the shoot uncovered last week. The extent of the find has not been determined. Hand-mortars are used in reducing much of the ore extracted.

Placerville.—Charles E. Swezey of Sacramento reports that the Grit Gold Mining Co. is planning to work the claims formerly held by Walter P. King and have found some extraordinary high-grade ore. The Hines-Gilbert mine is taking out ore preparatory to commencing operations in its 10-stamp mill.

Plumas County.—The Engels, Walker, Gruss, Beardsley, and other properties are producing, with the Engels and Walker shipping heavily. Diamond-drills at the Engels have demonstrated the occurrence of large deposits of profitable ore below the No. 7 level to a depth of 400 ft. The 200-ft. shaft connecting levels 6 and 7 has been completed and blocking of ore in this area begun. The flotation mill is making an excellent product from the Engels and Superior mines and activities are being increased as rapidly as more miners can be secured.

The Walker Copper Co., a subsidiary of the Anaconda Copper Co., has completed the aerial tramway to Spring Garden and is shipping its concentrate to the railroad station by way of the new transportation system. The tramway eliminates costly motor-truck service formerly in use. Diamond-drills have extended the ore limits of the main Walker deposits and proved that the orebodies extend to great depths beyond the main levels.

Sierra County.—The new rotary mill on the Kirkpatrick mine near Downieville is reported to be operating efficiently on the high-grade gravel.

IDAHO

C. J. Diebel, of Spokane, president of the United States Silver Lead Mines Co. has returned from a visit to the property in the Coeur d'Alene. Another 35 ft. in the cross-cut is expected to reach the vein at a depth of 135 ft. A. M. Nash is manager.——Paul Liver of Wallace was re-elected president and manager of the Giant Mining & Development Co. at the annual meeting. A cross-cut is being run which es expected to cut the vein soon. The property is on Sunset Peak in the Coeur d'Alene.——The Idaho-Northern Mining Co. of the Coeur d'Alene is about to extend its lower tunnel 1600 ft. additional depth on the orebody. Work was suspended by this company for a time four years ago. O. M. Nordquist is arranging for the resumption and Oscar Eckman will be superintendent.——Robert N. Bell, mine inspector of Idaho for many years, will take over and operate the Clayton mine in Custer county.——Three carloads of ore were shipped from the Jack Waite in the Coeur d'Alene the last of the month. The ore goes to Utah.——The shipments of zinc and of lead-silver ore and concentrate of the Consolidated Interstate-Callahan Mining Co. were 4576 dry tons less in the quarter ended June 30, than last previous quarter.

Coeur d'Alene.—The Hecla Mining Co. will disburse its regular quarterly dividend of $150,000 on September 28. This disbursement will increase the total of dividend payments this year to $500,000, an extra of $50,000 or five cents per share, having been paid with the regular dividend of $150,000 in June. This will bring the grand total up to $8,355,000. James F. McCarthy, president and general manager, said recently that the company was hoisting from 600 to 700 tons daily. He said that the main orebody, opened on the 2000-ft. level, had been followed by drifting for 500 ft. Its average width is 16 ft., and of a grade similar to that on the 1600-ft. level. The company is now employing 300 men and operated six days per week.

Gilmore.—The Pittsburgh-Idaho mine in the Gilmore district of Lemhi county is now shipping 30 cars of ore per month. The ore is a carbonate, averaging 25% lead and 12 to 15 oz. silver per ton. The 'Latest Out' property, in the same district, is shipping about 20 carloads per month.

Kellogg.– The raise in the Nabob Consolidated mine attained a point 175 ft. from the Nabob tunnel level, according to Henry Thornson, mill superintendent. This is 62 ft. from the Sidney tunnel level, the objective in the drive. The work is proceeding rapidly. Ground is being broken at the rate of five feet per day.——A vein has been found in the face of a 250-ft. tunnel on the property of the Central Idaho Gold Mining Co., near the Big Buffalo mine, in Buffalo Hump, according to reports. This is a blind vein, the main vein being 240 ft. ahead.——All the ore-bins of the Highland-Surprise property on Pine creek in the Coeur d'Alene are filled from ore mined during development. The ore is high-grade. Only a small force is working at present, but the company is considering plans for increasing the force, connecting the two levels by a 200-ft. raise, and possibly it will decide to start the mill.——The big smelter of the Bunker Hill & Sullivan company is doing a greater business than ever and steadily increases its force. Many mines are commencing or resuming work, and the fact that unpatented claims must be worked this year is making quite an important addition to the number of men employed in the district. The railroad to be built up Pine creek will greatly benefit this section.——Reports from the Lookout Mountain mine of the Pine Creek district of the Coeur d'Alene confirms the belief that the strike recently made is important. Two feet of good copper-silver ore was found and it is said that some of it looks as though it would pay to ship without milling.——At a meeting of the stockholders of the Bristol Mining Co. at Kellogg recently, a consolidation proposal with the Jim Blaine Silver Syndicate was accepted and the two properties merged. Machinery will be erected and the tunnel driven from the lowest point possible for the development of both veins. This will require about 1500 ft. of work and will secure over 800 ft. of depth on the vein. The properties are situated on the east fork of Pine creek, about half a mile from the fork, and the same distance from the proposed Pine Creek railroad.

Ophir.—Guy R. La Coste, president and general manager of the Ophir Silver Mines Co., accompanied by F. M. Wichman, consulting engineer, have been here. Mr. Wichman is making a thorough examination of the property, preparatory to a report. On the basis of this report decision will be made as to whether or not it will be advisable to open up the lower tunnel, which is in the formation a distance of 700 ft., and follow a strong vein of silver ore which is making toward and under the contact, but 70 ft. from the face of the adit. At present considerable water is making in the tunnel.

OREGON

Gold Hill.—Rich ore has been discovered in the Sylvanite group of gold mines by Victor W. Brown and associates of Pittsburgh, lessees. This property is the only quartz mine among those in operation in this region. Gold mining has been almost wholly suspended in this region since 1914, excepting the hydraulic placer mines which have extensive water-rights. The new find was made in the old workings at a depth of more than 600 ft., and contains ore worth from $20 to $50 per ton in gold and silver. The several mines constituting the group, known as the Simmons, Cheney, Haff, and Ray mines, have been gold producers for 30 years.

Tungsten was discovered in this property in 1916 by Ray & Haff of Gold Hill, who were operating the mine. The tungsten occurs in small stringers with quartz, and ore containing from 2 to 40% tungsten was extracted. The veins carrying the best grade of tungsten have been developed only to a small extent and the tungsten resources of the mine, therefore, have not yet been determined. The increased amount of this metal required for tool steel and incandescent lamps has kept up the interest of prospectors in the district.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Karl Eilers is in San Francisco.

Henry Krumb, of Salt Lake City, is in New York.

J. H. Hottendorf, of Bridgeport, Oregon, is at Yreka, California.

A. E. Roesler is now operating at West Point, in Calaveras county.

S. L. Boyes has moved from Grants Pass, Oregon, to Los Angeles.

Walter H. Wiley has returned from the Coeur d'Alene to Los Angeles.

L. Venn Brown has returned from King island to Sydney, New South Wales.

Samuel W. Cohen, of Montreal, is in Newfoundland examining mining property.

O. M. Kuchs, general manager for the International Smelting Co., of Salt Lake City, is at Chicago.

Frank A. Love, recently of Inspiration, Arizona, is now with the Alvarado M. & M. Co., at Parral, Mexico.

C. W. Purington has left Hakodate, northern Japan, for an examination of the coalfields of northern Sakhalin.

George C. Bartells, who has been conducting research work at the Murray smelter, Utah, has returned to St. Louis.

Charles C. Selbie, of Pasadena, California, sailed from New York on September 4 for the Congo, by way of Antwerp.

G. Howard Birch and **Arthur J. Striker** have removed their offices from 160 Broadway to 522 Fifth Avenue, New York.

Ernest Levy, on his return from Cuba, has gone to London to accept a partnership in the firm of Alexander Hill & Stewart.

R. O. Dobbs has been making an investigation of the Ada H property, adjoining the Spruce Monarch mine near Wells, Nevada.

R. S. Baverstock has returned to Los Angeles from a trip to the Paymaster and President mines in Imperial county, California.

Frank P. Knight, of Boston, president of the Iron Cap Copper Co., recently visited the company's properties at Copper Hill, Arizona.

Sidney R. Stanford has left the Constancia mine, to become mine superintendent for the Nicaragua Mining Co., at Bluefields, Central America.

Charles E. Prior has left the Premier mine in British Columbia, to accept a position on the staff of the Mexican Corporation, at the Fresnillo mine, in Mexico.

T. Hasegawa, K. Mimura, and **J. Matsumoto,** connected with the Sumitomo copper works at Osaka, Japan, have been visiting mining and metallurgical plants in Utah.

T. R. Arnold, formerly chief electrician for the Arizona Copper Co., has accepted the position of electrical engineer for the Southwestern Portland Cement Co. of El Paso.

Howland Bancroft has accepted the appointment of manager for the Sinclair Panama Oil Corporation and will move to Panama forthwith. He sails from New York on September 22.

L. D. Ricketts, who has been spending the last few months in Santa Barbara, California, is making an inspection of the Inspiration and Calumet & Arizona properties, prior to visiting New York.

Carl A. Allen, State Mine Inspector of Utah; **George Murphy,** superintendent for the Spring Canyon Coal Co.; and **R. M. McGraw,** general superintendent for the United States Fuel Co. were among those who attended the convention at Denver, beginning September 9.

Eastern Metal Market

New York, September 8.

The prevailing dullness in all the markets has been rendered more pronounced by the Labor Day holidays.

Buying of copper is at a low ebb but inquiries are more numerous.

The tin market has a better tone with some buying by consumers.

The lead market has declined because of offerings of imported metal.

The condition of the zinc market is similar to that of the lead.

There is no material change in antimony.

IRON AND STEEL

The waiting attitude of buyers of pig-iron and steel has been more marked in the past week, says 'The Iron Age'. Pressure for early supplies of everything in finished steel, with the possible exception of tin plate and wire products, has disappeared. Buyers generally seem confident that they can get steel for 1921 when they need it and at prices not above those of today.

Pig-iron production in August, under better railroad-operation, rose to a point only exceeded this year by March and in 1919 by January alone. The total was 3,147,402 gross tons, or 101,529 tons per day, as against 3,067,043 tons in July, or 93,965 tons per day. September promises further increase. Twenty-three furnaces were blown in last month and five were blown out—a net gain of 18.

With the large volume of unshipped orders that is on the books of the mills, prices are little affected by the halt in buying, but the basis of future contracting is concededly a two-sided question, whereas in July the shortage in steel supply seemed the decisive factor.

COPPER

Despite the fact that buying of copper has shown no improvement in actual sales, inquiry from large consumers is increasing which is taken as an evidence that stocks are being depleted and that a buying movement will, and must, materialize inside of two weeks or so. While most of the large producers are adhering to the 19c., New York, quotation for both Lake and electrolytic copper, there are evidences that a few are taking some business as low as 18.75c. and that the light demand afloat is being taken care of at around those levels by these few sellers as well as by the smaller producers and dealers. Foreign sales continue moderate and satisfactory under the circumstances. On the whole sentiment in the trade is better than for some time and there is a feeling that better times as well as better prices are near at hand. The British market has been almost buoyant the entire week.

TIN

For the first time recently there have been sales made to consumers. Two importers report moderate buying last week from this source, some for October-November arrival and some for September-October shipment from the East at 45.50 to 46c. On the whole the market has been only moderately active. There has also been an increase in business done on the New York Metal Exchange, total sales for the week amounting to about 250 tons at prices ranging from 45 to 45.50c., depending on the position, mostly future shipment. Last Thursday one buyer had to sacrifice 100 tons, ex-ship at dock, by selling it under the rule at 45.12½c. to 45.50c. in four lots. On Friday the market closed higher with spot at 45.50c. and futures held at 46c., at which level some business was done. Spot Straits New York, yesterday was 45c. The London market yesterday was £264 10s. per ton for spot standard, £270 10s. for future standard, £272 for spot Straits, and £280 for Singapore, all lower than a week ago. Deliveries of tin in August are reported at 3745 tons, of which 3400 tons came in at Atlantic ports. The quantity in stocks and landing on August 31 was 3256 tons. Total tin imports to September 1, 1920, were 36,688 tons, as compared with 11,556 tons to September 1, 1919.

LEAD

There is little new to be said. The controlling factor is the importation of lead which is a cause of some pressure. While demand in general is not heavy, several sales have been made at around 8.50c., New York. Consumers are understood to have, in some cases, expressed hesitation in accepting foreign lead on the assumption that it may not be as good in quality as American metal. The fact that it has been and is being offered in competition with domestic lead is the basis of an argument that the domestic price should also fall. Thus far the quotation of the leading interest has not been changed and is still 8.75c., St. Louis, or 9c., New York. We quote the outside market at 8.50c., New York, or 8.62½ to 8.75c., St. Louis, the latter being higher than New York, an unusual condition.

ZINC

The situation in this market is similar to that in the lead in that imports of zinc are a source of weakness but not to so pronounced a degree as in the other case. There continue to be offerings and sales of prime Western zinc for reshipment from England which have depressed the Eastern market to a level practically equal to the Western or St. Louis quotations. Prime Western for early delivery is quoted at 7.90 to 8c., New York, and at 7.90c., nominal, St. Louis. Consumers are uninterested and are not making inquiries, much less buying, and producers insist there is no profit in selling at present levels. They therefore sell only under compulsion to regular consumers.

ANTIMONY

This market is inactive with quotations unchanged at 7c., New York, duty paid, for wholesale lots for early delivery. Jobbing lots are held at 7.25 to 7.50c.

ALUMINUM

The price of the leading interest is unchanged at 34.90c., f.o.b. producer's plant, for wholesale lots of virgin metal, 98 to 99% pure, for early delivery, while other sellers are offering foreign and other metal at 32 to 33c., New York.

ORES

Tungsten: The market is quiet and devoid of features. Quotations are unchanged at $5 to $5.25 per unit in regular concentrates, according to grades, quantity, and delivery.

Ferro-tungsten is unchanged at 80c. to $1.05 per lb. of contained tungsten.

Molybdenum: Dullness pervades this market with prices unchanged at 75c. per lb. of MoS_2 in regular concentrates.

Manganese: The market is weak with buyers apparently unwilling to pay more than 55c. per unit, seaboard, for high-grade ore, while sellers are asking 65c. per unit.

Manganese-Iron Alloys: Demand for both ferro-manganese and spiegeleisen is light. Quotations are unchanged from the recent decline and are $170, seaboard, as a base for delivery this year, for ferro-manganese, and $82.50 to $85, furnace, for the higher grade of spiegeleisen. There are indications that some electric producers will abandon production of ferro-manganese. One Eastern electric ferro-alloy maker is producing silico-manganese containing 15 to 20% silicon and 45 to 55% manganese which is selling for $200 to $225 per ton, furnace.

THE METAL MARKET

METAL PRICES

San Francisco, September 14

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9 50
Copper, electrolytic, cents per pound	19.25
Lead, pig, cents per pound	8 75—9 75
Platinum, pure, per ounce	$115
Platinum, 10% iridium, per ounce	$165
Quicksilver, per flask of 75 lb	$75
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

September 13.—Copper is dull and easy. Lead is quiet and soft. Zinc is inactive but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Sept. 7	94 50	59.50	Aug. 2	92 85	56.20
" 8	94 00	59.00	" 9	94.58	58.39
" 9	93.50	Holiday	" 16	95 39	59.05
" 10	94.25	59.00	" 23	99.12	61 60
" 11	93.50	59.00	" 30	96 61	60.70
" 12 Sunday			Sept 6	93 27	58.90
" 13	94.00	59.37	" 13	93 96	59.15

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95 35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99 50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Sept. 7	18.75	Aug. 2	19.00
" 8	18.75	" 9	19.00
" 9	18.75	" 16	19.00
" 10	18.75	" 23	19.00
" 11	18.75	" 30	19.00
" 12 Sunday		Sept. 6	19.00
" 13	18.75	13	18.75

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26 00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26 00	22.11	....
Apr.	23 50	15.23	19.23	Oct.	26 00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20 45	....
June	23 50	17.53	19.00	Dec.	26 00	18 55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Sept. 7	8.50	Aug. 2	9.06
" 8	8.50	" 9	9.00
" 9	8.25	" 16	9.06
" 10	8.75	" 23	9.19
" 11	8.75	" 30	8.85
" 12 Sunday	8.75	Sept. 6	8.50
" 13	8.75	13	8.29

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6 85	5 00	8 05	July	8 03	5 53	8 03
Feb.	7 70	5 13	8 88	Aug	8 05	5 78	9 03
Mch.	7 26	5 01	9 22	Sept.	8 05	6 02	....
Apr.	6 99	5 05	8 78	Oct.	8 05	6 40	....
May	6 99	5 01	8 55	Nov.	8 05	6 76	....
June	7 59	5 32	8 43	Dec.	6 90	7 12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49 29
Feb.	85.00	72 44	59 87	Aug.	91.33	69 20	47.60
Mch.	85.00	72.50	61 92	Sept.	80.40	55 79	....
Apr.	85 00	72 50	62 12	Oct.	78.82	54 82	....
May	100 01	72 50	59 99	Nov.	73 67	54.17	....
June	94 00	71 54	58 43	Dec.	71.52	54 94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Sept. 7	7.90	Aug. 2	8.11
" 8	7.80	" 9	8.12
" 9	7.75	" 16	8.27
" 10	7.75	" 23	8.42
" 11	7.75	" 30	8.45
" 12 Sunday		Sept. 6	8.29
" 13	7.75	" 13	7.78

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.87	6.53	8.93	Sept.	9.58	7.57	....
Apr.	7.04	6 49	8.76	Oct.	9.11	7.82	....
May	7.92	6 43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Aug. 30	85.00
Aug. 17	85.00	Sept. 7	75.00
" 24	80.00	14	75.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan	128 06	103.75	89.00	July	120.00	100 00	88 00
Feb.	118 00	90.00	81 00	Aug.	120.00	103.00	85.00
Mch	112.00	72.80	87 00	Sept.	120.00	102.60	....
Apr.	115.00	73.12	100 00	Oct.	120.00	86.00	....
May	110 00	84.80	87 00	Nov.	120 00	78.00	....
June	112.00	94 40	85.00	Dec.	115 00	95.00	....

THE FRENCH LOAN

American investors are given tomorrow the opportunity to subscribe at par to $100 000 000 bonds of France. Already the applications assure an over-subscription. There are abundant reasons why this should be so, says the 'Boston News Bureau', under date of September 8. There are first, and also foremost, the cold-blooded reasons of dollars and cents. France, which once used to issue 3% rentes, is compelled by the world-wide post-war conditions of capital cost to offer 8% now—just as Switzerland also recently had to do. Our own government is again borrowing for a year at 6%. More than that, France binds itself to devote $4,400,000 per year to a sinking-fund that shall buy back these 25-year bonds at 110, and after five years a portion of the bonds are to be drawn by lot for such redemption at 110.

There is a larger business reason than the individual one of investment attraction. These bonds represent really an extension of previously granted credit. In fact the Anglo-French 5s, maturing October 15, are applicable in subscription to their 8% successors—so far as France was concerned. That need of credit extension has been dinned into the ears of American investors as the obvious outstanding requisite of the international economic situation. It is the procedure which any intelligent merchant would apply under parallel conditions in his own business. We as a nation have been merchants on a huge scale. Here is one of the first concrete cases.

England and France jointly borrowed the $500,000,000 about to mature. For patent reasons of greater relative wealth, less war hardship, and more control of exchange and credit facilities England has been in position to take care fully of its half when due. She sent us about $75,000,000 gold and arranged for the rest through security sales, buying of exchange, and other devices. England's exports today exceed her imports when to the former are added her 'invisible exports'—investment interest, freight, and insurance earnings. She is still netting about $80,000,000 per month on capital abroad against nearly $100,000,000 per month before the War.

But France is not so advantageously situated. Yet she is easily able to offer the other business incentive—strong security that justifies her seeking partial credit. She attends to $150,000,000 of her obligation by funds already assigned and also by gold to be sent us, of which $4,000,000 is already on the water. There will be a big influx of gold hither this fall to bolster our slowly dropping reserve ratios.

There is the further promise of security in the steady recovery of her industry at home and her trade abroad—plus, at bottom, the wealth and the character of the French people. In the first seven months of this year [illegible] reduced her trade deficit [illegible] the adverse balance from 14,250,000,000 to 9,750,000,000 francs. While [illegible] 7,230,000,000 francs.

[illegible] —bears willing testimony to the marked progress in economic reconstruction already achieved by the French. And after the Anglo-French maturity is taken care of, the exchange value of the franc should materially improve.

MONEY AND EXCHANGE

[illegible] on September 14 [illegible]

[illegible]	[illegible]	3 16⅞
[illegible]	Demand	3 17
[illegible]	[illegible]	6 56
[illegible]	Demand	6 57
[illegible]	Demand	1 50
[illegible]		1 [illegible]

Book Reviews

Silver. By Benjamin White. Pp. 140, ill. Sir Isaac Pitman & Sons, Ltd., London. For sale by 'Mining and Scientific Press'. Price, $1.

An odd combination of historical, technical, industrial, statistical, and monetary information regarding silver, is this small volume. It starts with a dash of geology and ends with a large table showing the price of bar silver in London by months from January 1833 to December 1918. There is much of general information in the book for the casual reader, but no particular phase of the subject is treated at any length. It is written as one of a series devoted to "commodities". The author correctly defines silver as a commodity and shows its "intimate association with the daily life of man".

Shop Mathematics. By Erik Oberg and Franklin D. Jones. Pp. 275, ill., index. The Industrial Press, New York. For sale by 'Mining and Scientific Press'. Price, $3.

This book is intended for machinists, tool-makers, and apprentices, primarily for those whose previous mathematical education has been incomplete. The book reviews arithmetic, and discusses such elementary algebra, geometry, and trigonometry as is especially applicable to shop calculations. Most of the book is devoted to the application of the mathematical theories already discussed to the solution of machine-shop problems, such as setting tapers, change-gears, indexing on the milling machine, and gear-cutting. The book would be improved by the addition of an appendix containing the mathematical tables most commonly used in machine-shop calculations, but, even as it is, it will be useful to shop-men.

Elements of Steam and Gas Power Engineering. By Andrey A. Potter and James P. Calderwood. Pp. 297, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $2.50.

This book is designed primarily as an elementary textbook for engineering students but could also be used to advantage by others interested in the subjects discussed. The first chapter is devoted to the fundamentals of power engineering, following which the various divisions of steam power-plant work are discussed including engines, turbines, boilers, auxiliaries and accessories, a chapter being devoted to each of the principal divisions of the subject, including power-plant testing. Internal-combustion engines are next considered, including general engine-design, fuels, and auxiliaries, particularly carbureters and ignition systems. Chapters are also devoted to locomotives, and to automobiles, trucks, and tractors.

Retaining-Walls. By George Paaswell. Pp. 269, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $4.

The construction of retaining-walls dates back to prehistoric times, but, as the author points out, scientific design is comparatively modern, while the increasing use of reinforced concrete calls for something more accurate than the empirical methods frequently used with the gravity-wall. The present volume is divided into two parts of approximately equal length. Part I, after discussing the various methods of computing earth pressures and surcharges, considers gravity-walls, reinforced concrete walls, and various special wall-sections. A chapter is also devoted to temperature, shrinkage, and other factors of general influence. Part II, on construction, discusses the plant required, formwork, and general methods of constructing both concrete walls and walls other than concrete. Architectural treatment, drainage, waterproofing, surveys, and office work are also considered. An appendix contains skeleton specifications and a bibliography. The book will be of value to anyone designing or constructing a retaining-wall.

Electro-Deposition of Metals. By Dr. George Langbein and William T. Brannt. Eighth edition. Pp. 875, ill., index. Henry Carey Baird & Co., New York. For sale by 'Mining and Scientific Press'. Price, $7.50.

This is the eighth edition of a standard work; it has been revised and enlarged so as to serve as a thoroughly comprehensive textbook to those who desire to learn about the plating and finishing of metals. It is written in plain and understandable English and gives a number of valuable formulas for the solutions used in the trade. In the main it is a translation from the German by George Langbein, but it includes many additions and revisions by William T. Brannt, the translator. From the chapter devoted to an explanation of the related phenomena of magnetism and electricity, the reader is led to an account of the sources of the current used in the electro-deposition of metals, and then to a description of an electro-plating establishment. Then come details as to the preparation of the metallic objects, the deposition of the various metals. We commend the volume to those at all interested in an increasingly important phase of metallurgy.

Geology of the Mid-Continent Oilfields. By T. O. Bosworth. Pp. 282, ill., index. The Macmillan Co., New York. For sale by 'Mining and Scientific Press'. Price, $3.

Although prior to 1903 their output was negligible, the Mid-Continent fields, including Kansas, Oklahoma, and northern Texas, have up to the present time produced nearly one-sixth of the total from all the fields in the world since the drilling of the Drake well. Development has been so rapid that the available information regarding the fields has hardly kept pace with it, and such information as is available is scattered, and is found mainly in various bulletins of Federal and State bureaus. The present volume covers the principal facts about the geology of the various fields and, in addition, gives references to the sources from which more detailed information can be obtained. Besides the discussions of the geological structure, there are chapters on the character of the oil in the different fields, on the natural gas found in some of the fields, on the salinity of oilfield-waters, and on the production of gasoline from natural gas. The man who wants to inform himself regarding the Mid-Continent field will need this book.

Popular Oil Geology. By Victor Ziegler. Pp. 166, ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $3.

That in two years a second edition of this little book has become necessary is in itself an indication of its usefulness. The preface states that the book is designed for the man without technical or scientific training. As such it gives a sort of birdseye view of the subject with particular reference to the Mid-Continent and Rocky Mountain fields. The first chapter is devoted to the general history and statistics of the petroleum industry. The next discusses the physical and chemical properties of oil and gas, following which there is a brief discussion of the various theories of the origin of oil and gas. Several chapters are then given to a discussion of those geological phenomena that affect the migration of oil, and to the application of a knowledge of these phenomena to prospecting for oil. A chapter is devoted to the oil-shale industry and the final chapter discusses oil investments. The principal differences between the second edition and the first are the rewriting of the chapters on oil-shales, the migration of oil and gas, and the anticlinal theory.

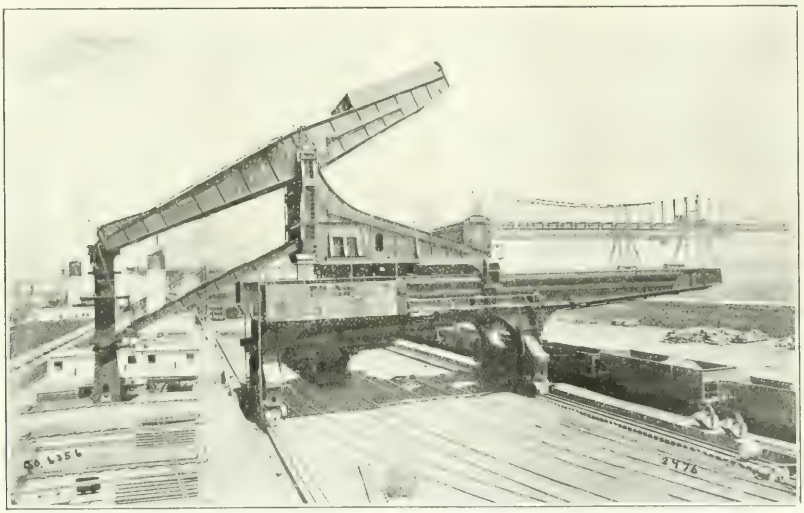
INFORMATION FURNISHED BY MANUFACTURERS

IMPROVEMENTS IN BULK-CARGO HANDLING

In the past four years several factors have stimulated interest among shippers of heavy bulky materials in a cheaper and more rapid scheme of handling such commodities. The manufacturers of apparatus, especially the pioneers in this line, started a movement in this direction some twenty years ago, and succeeded in getting a limited number of plants installed as early as 1902. The development of plants for handling large tonnage of coal and iron ore was the most obvious necessity and it was naturally the first problem attacked on a large scale. The necessity for such development centred around the Great Lakes region and the first plants were built in this vicinity. The short season of navigation from the Minnesota, Wisconsin, and Michigan mining districts to the blast-furnaces of the lower lakes and the Pittsburgh district, require a movement of twelve-month supply of ore in about seven months. The coal supply of the States bordering on the iron-ore region was largely taken from the lower lakes on the return trip of the same boats. In order to perform this task with the minimum operating costs, it was necessary to provide machinery for cheap and rapid discharge of cargo from ship to dock or railroad, and vice versa, the length of time the ship was tied up to the dock being a vital factor in costs. The result has been a high state of development and concentration of bulk cargo handling plants in the Lakes region. In the late nineties the Wellman-Seaver-Morgan Co. brought out its ore-unloader, each machine capable of handling ore at a rate from 500 tons per hour, upward.

A recent contract with the Lehigh Valley Railroad Co. covers an automatic ore-unloader carrying a 15-ton clam-shell bucket on the unloader leg and designed to make a complete cycle or round trip in 50 seconds. The machine electrically operated throughout is shown in Fig. 1.

The unloader consists of a main framework mounted on trucks which travel along the runway-rails that are placed approximately as shown in the illustration. The main framework extends back beyond the rear runway over a temporary storage pile where the ore can be discharged if desired. It is then picked up by the ore-bridge and carried to the stock-pile. Between the front and rear runways, space is provided for railroad tracks where ore-carrying cars are placed under the machines and loaded with ore for transportation to the furnaces. The girders of the main framework form a support for runway-rails, on which a trolley travels. This trolley supports a balanced walking beam, from the outer end of which a stiff bucket-leg depends. At the lower end of this leg is the bucket, which is operated by machinery placed on the walking-beam. All horizontal movements of the bucket are accomplished by moving the trolley backward and forward on the girders. The vertical movements of the bucket are accomplished by the operation of the walking-beam. The forward portion of the beam being out of balance, the bucket descends by gravity as soon as the brakes of the hoisting mechanism are released.



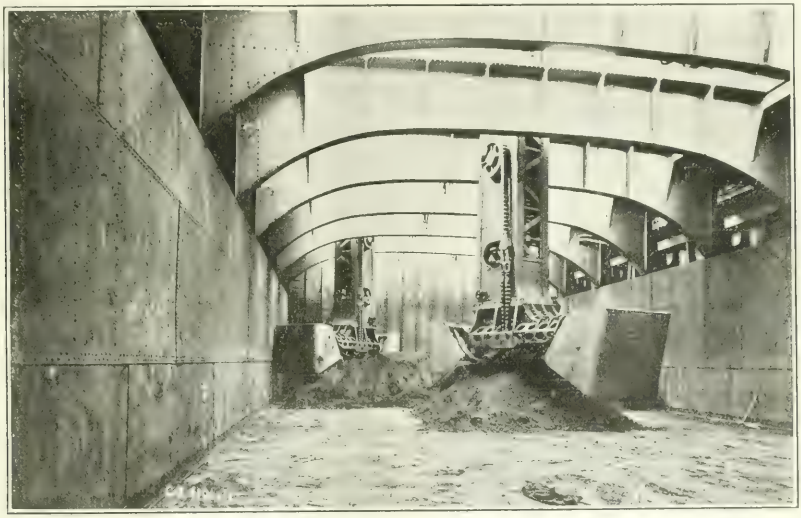
Electrically-Operated Ore-Unloader

Only two men are required for the entire operation of one of these machines. One of the operators, whose station is in the bucket-leg directly over the bucket-shells, controls all of the motions of raising and lowering the bucket, of traveling the trolley back and forth, and moving the ma-

chine along the dock from one hatch to another. The second operator is stationed in a cab on the larry and from this station he controls the movements of the larry, the operation of the larry-gates, and the weighing of the ore.

Some idea of the capacities of unloading by this method may be derived from a record which was made in Ashtabula by eight machines of this type having a capacity of 15 tons each, unloading seven boats having a total capacity of 70,000 tons in 22 hours actual time. At another point, four machines working in boats having capacities of 13,000 tons have unloaded these cargoes in about three hours and twenty-five minutes.

In addition to the vertical movement, which is given to the bucket-leg by means of the walking beam, it also has a motion of rotation around its vertical axis. This motion is



Clam-Shell Bucket in Operation

introduced to enable the machine to reach along the keel of the boat and clean up ore between hatches. The distance from point to point of bucket-shells when open is approximately 21 ft. About 97% of the ore is removed from the boat without hand labor. Records of fifty machines in operation indicate that this type of machine will handle ore at 2¾ to 4½c. per ton including all fixed charges, and records of as high as 783 tons of ore per hour per machine from tie-up to cast-off of boat have been made. The Lehigh ore-unloader will be installed at the Claremont terminals, New York harbor, to handle ore from Chile and Cuba.

FUNDEMENTAL PRINCIPLES OF INDUSTRIAL EMPLOYMENT RELATIONS

Employment relations should accord with and express ideals of justice, equality, and individual liberty. The terms of employment should conform to the essential requirements of economic law and should, through intelligent co-operation, based on a recognition of mutuality of interest, conduce to high productive efficiency. They should reflect an effort to realize ideals of individual and social betterment.

Principles

I—The Employment Relation

Every person possesses the right to engage in any lawful business or occupation and to enter, individually or collectively, into any lawful contract of employment either as employer or as employee.

II—The Open Shop

The right of employer and employee to enter into and to determine the conditions of employment relations with each other (without reference to the affiliation or non-affiliation of either with any organization) is an individual right of free contract possessed by each of the parties.

III—Right of Association

All men possess the equal right to associate voluntarily for the accomplishment of lawful purposes by lawful means. The association of men whether of employers, employees, or others, for collective action or dealing, confers no authority over, and must not deny any right of, those who do not desire to act or deal with them.

IV—Responsibility of Combinations

The public welfare, the protection of the individual, and sound employment relations equally require that all associations or combinations be subject to the authority of the State. As the public interest is paramount, full publicity of facts of industrial relations is necessary.

V—Obligation to Secure Production

To develop, with due regard for the health, safety, and well-being of the individual, the maximum capacity and output required of industry is the common social obligation of all engaged therein.

VI—Wages and Management

The wage of labor must be drawn from the product of industry and must therefore be earned and measured by its contribution to production. All employees are entitled to complete business information in matters affecting the terms of their employment; and frankness is essential. In order that the worker, in his own and the general interest, may develop his full productive capacity, it is the duty of management to assist him to secure regular employment suited to his abilities, to furnish him with incentive and opportunity for self improvement, and to provide proper safeguards for his health and safety.

VII—Hours of Labor

The number of hours in the work day or week in which re-

*Proposed by Committee on Labor of Associated General Contractors of America.

quired maximum output, consistent with the well-being of the workers, can be maintained in a given industry should be ascertained by careful study and never should be exceeded except in case of emergency. One day of rest in seven, or its equivalent, should be provided.

VIII—Adjustment of Employment Relations

Adequate means satisfactory both to the employer and to his employees, and voluntarily agreed to by them, should be provided for mutual discussion and adjustment of employment relations.

IX—Community of Interest

The greatest measure of reward and well-being for both employer and employee, and the full social value of their service to the public must be sought in the successful conduct and full development of the industrial establishment in which they are associated. Intelligent and practical cooperation based upon a mutual recognition of this community of interest constitutes the true basis of sound industrial relations.

X—Government Employment

The State is sovereign and cannot tolerate a divided allegiance on the part of its officers and servants. While the right of government employees, national, State, or municipal, to be heard and to secure consideration and just treatment should be amply safeguarded, the community welfare demands that no combination shall be permitted to prevent or impair the operation of government or of any governmental function.

XI—Public Service Employment

In public service activities the public interest and well-being must be the paramount and controlling consideration. The power of regulation and protection exercised by the State over the corporation should properly extend to the employees in so far as may be necessary to assure the adequate, continuous, and unimpaired operation of public-utility service.

The Committee on Labor of the Associated General Contractors desires the greatest possible publicity and discussion of the foregoing statement. It invites constructive criticism in order to perfect this draft, if necessary.

It is hoped that it may ultimately be widely adopted as the guide for all industrial employment relations.

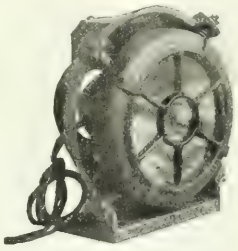
'RF' ADJUSTABLE-SPEED MOTORS

A second edition of bulletin No. 41021A, superseding bulletin No. 41021 and describing the latest design of RF, Form A, direct-current adjustable-speed motors rated from ¾ to 50 intermittent horse-power, comes from the press of the General Electric Co. A compensating winding practically eliminates flux-distortion losses, which may amount to from 5 to 10% in the conventional commutating-pole adjustable-speed motor. To prevent field-distortion the compensating winding is distributed instead of concentrating it at the commutating pole-faces, the magnetizing strength of this winding being equal to and in the direction of magnetization, opposite to that of the armature-winding. The wide and stable commutating zone thus established by a commutating and compensating winding, the latter being concentric to the commutating poles assures practical elimination of commutation troubles even with careless operation.

For ordinary service, driving shapers, slotters, and lathes, a simple type of drum-controller can be used. A more simple type of magnetic control can also be employed, and the motor is particularly suitable for reversing-planer operation, pipe-threading, tapping, or for driving any machine repeating its cycle of operation. Current peaks are limited by the inherent characteristics of the motor. Acceleration from basic speed to high speed may be effected by inserting the total field resistor in one step. For heavy flywheel-loads special control is necessary. The RF motor is rated on the continuous two-hour basis and, in addition, the main field-coils are designed to withstand, without injury, full potential continuously with the armature at rest.

MINE LOCOMOTIVE HEADLIGHT WITH SPRING SUSPENDED CASE

To withstand the severe conditions under which they are used, the mine-locomotive headlights placed upon the market by the Westinghouse Electric & Manufacturing Co. have been designed so that the incandescent-lamp case is carried on a spring suspension which adequately protects the filament from breakage due to vibration and jars. The case, which contains the socket and lamp, is entirely suspended



Headlight in Spring-Suspension

from six springs. These springs are placed symmetrically and are in tension. Thus the spring-suspension is equally effective in all directions, assuring the longest possible lamp-life. This type of suspension is very much superior to the usual type employing helical springs in compression. The new Westinghouse headlight responds to the slightest pressure in any direction assuring perfect cushioning, while the usual type requires a considerable force to be exerted in any direction before any movement takes place, which means that only partial cushioning is obtained. The frame, case, and cover of this headlight are made of high-grade cast-iron, heavy enough to withstand a great deal of abuse. As the lens-holder is fitted to the case with a threaded joint and rubber gaskets, the headlight is tightly sealed and, therefore, suitable for use in gaseous mines. Where headlights are to be operated on circuits of more than 250 volts a resistance is supplied. This resistance is housed in a full cast-iron case of sturdy construction, which is superior to the sheet-steel housing usually furnished.

'Massco Furnaces' is the title of Bulletin No. 63 just issued by the **Mine & Smelter Supply Co.** It deals with oil-fired appliances. Oil as a fuel in industrial plants has come into widespread use on account of its convenience, ease of control, and in many places its economy. Oil is considered the modern fuel just as electricity is considered the modern power. The advantages of oil as compared with most fuels are, its ease of handling, freedom from dirt, and the complete elimination of ashes. Less labor is required. In addition to these it has a high fuel-value. An intense heat may be quickly secured and when no longer needed fuel-consumption can be immediately stopped by closing the valves. This means the lowering of fuel costs and an increase in the efficiency of operation. Even in places where the cost of coal and oil are comparable, convenience, cleanliness, and ease of control may be the determining factors. Massco oil-burning furnaces are primarily designed for a low-pressure system. Since conditions vary in many localities the company does not, however, recommend one type of burner for every equipment. The kind to be selected depends on local conditions as to power and air facilities.

T. A. RICKARD, - - - - Editor

ACCORDING to the revised figures of the Mint, the output of gold in the United States last year was $60,333,400, which is about $2,000,000 more than the previous estimate, while that of silver was $63,533,652, or $1,500,000 more than the preliminary estimate. In fine ounces the output in 1919 was 2,918,628 of gold and 56,682,445 of silver, the decrease in production being $8,313,300 for gold and $11,127,000 for silver. In gold California was first, with a yield of 841,638 ounces, worth $17,398,200. Colorado was second and Alaska third. Montana produced the most silver, the yield being 15,012,258 ounces, most of which was extracted from ores chiefly valuable for their zinc and copper contents.

ON the occasion of the recent International Mine-Rescue competition at Ladysmith, in British Columbia, the Provincial Minister for Mines, Mr. William Sloan, referred to the unfortunate accident at the Black Diamond mine in Washington as a 'set-back' to mine-rescue work. A report has been issued by the Chief Inspector of Mines for British Columbia, who was sent to make an investigation, and was afforded every facility to do so by the Inspector of Mines of Washington. It appears that a team engaged in practice went into workings that were particularly dangerous without an adequate supply of oxygen. Two members of the first team to enter the mine succumbed and later a member of a team that came to the rescue also lost his life. The members of the two teams had been provided with apparatus that differed in type and functioned variously. The disaster was entirely unnecessary, as there was no need for a team engaged in practice to enter seriously dangerous workings. The lesson taught by the accident is the standardization of mine-rescue equipment. Already steps have been taken by Mr. Sloan to co-operate with the U. S. Bureau of Mines in adopting a uniform apparatus in the coal mines of this continent.

DANIEL GUGGENHEIM made some interesting remarks, which we quoted, just before sailing for Europe. He has something to say on his return. It is cheerful. He says that it is a sad mistake to think that "Europe will not have enormous purchasing power in the future, and that Europe is doomed to ruin". It would be sad indeed if true, and we are glad that Mr. Guggenheim feels confident to the contrary. The countries on the other side are "pulling themselves together in a remarkable way". That is good news. But, he adds, "we cannot expect an immediate recovery to normal conditions", owing to the after-effects of the War. We are inclined to chortle over the appreciation of the dollar, as compared with European currency, but Mr. Guggenheim says advisedly that "the low exchange-rates will prove of great benefit to the depleted countries so far as getting production under way is concerned. This is particularly true of Germany". In order that the world, of which we are an integral part, may be restored to industrial health, we must give credit to Europe, as Europe used to do to us. "We must sell them goods and allow them time to meet the payments. If we expect those countries to produce, we must supply the materials with which to work." All of which is true, and therefore worth repeating.

INTEREST in Mexican mining is increasing, thanks to the multiple signs of better government. The excellent price for silver is another favorable factor. In London there is a cheerful tone in this part of the mining share-market owing to the handsome earnings being made by the Santa Gertrudis, El Oro, and other well-established enterprises, while the various exploration companies have men in the field looking for new ventures. In New York likewise there is a better feeling toward Mexican mining and the smelting companies are increasing the scope of their operations, which however are still handicapped by the shortage of railroad-cars, so many of them having been destroyed during the years of revolution. Some of the mining and smelting companies are building their own cars and using them under special arrangements with the Government. The new President, General Obregon, has published an article in the current issue of the 'Mexican Review' in which he promises to protect every legitimate interest in the country, whether foreign or domestic. "What Mexico needs at the present time", he says, "is less fighting and more work." We seem to have heard an echo of that remark, or one of which it is itself the echo, in Europe. Even truisms wear a strange solemnity in days like these. Señor Obregon purposes to recognize the foreign debts of Mexico, and to pay interest and principle as they become due, so far as practicable; and to compromise on the over-due interest. He says that the army is to be reduced to 50,000 men, but they will be well paid and well equipped. Mexico needs more laborers and fewer soldiers, which is

a polite way of saying more workers and fewer bandits. Meanwhile we feel confident that the forthcoming administration at Washington will recognize the Obregon government, if such action is not anticipated by President Wilson, as we trust it may be. The United States and Mexico must live on friendly footing and our people must try to understand their southern neighbors. To that end we take pleasure in publishing a timely article on the Mexicans, describing their racial origins and their national traits. This article, as the reader will discover for himself, is written by one who has lived in Mexico and is in a position to understand the people of that country. On account of his frankness, and being a consulting engineer, likely to go to Mexico soon, the author prefers not to disclose his identity.

Industrial Leadership

The current 'Atlantic Monthly' contains an article that ought to be read by the members of the mining profession, because the subject is 'Industrial Leadership and the Manager' and also because the writer of it is Mr. Sam A. Lewisohn, of the firm of Adolf Lewisohn & Sons, honorably prominent in the copper-mining industry. Mr. Lewisohn discusses the efforts made by the managers of big companies to modernize their labor policy by joining a liberal spirit to the striving for efficiency. Indeed, he claims, justly, that efficiency of industrial management is attainable only by a sympathetic attitude toward the men employed. He has no patience for "mere railing against the closed shop and petulant complaining against restricted efficiency". With the growth in the complexity of modern operations and the increased application of technology it has become necessary for the old owner-managers to step aside in favor of engineer-managers, graduated from technical schools. The personal equation remains as of yore; it is still the chief factor in the problem of industrial leadership, but the formula has been complicated by new elements. The creation of a good morale in a mine or mill has been made the study of specialists, known as employment managers, efficiency experts, and welfare workers, but in the end the success of any such systematic effort to promote an *esprit de corps* in the face of labor unrest will depend upon the personality and character of the chief, the resident manager. If the administration is to be unified and consistent, the industrial specialist and the manager must work in harmony, and it is the manager that must strike the dominant note. The manager of a mine discovers only too often that his directors, even engineers who have developed into successful financiers, are out of touch with working conditions, because these have changed since they themselves were in charge of operations. By living in large cities, by associating with a different class, by lack of contact with working-men the head officials of a company lose the ability to understand labor conditions; so that the manager may find himself sometimes out of sympathy with them. They should realize their detachment from the work and give him a free hand. We are hardly surprised to learn from Mr. Lewisohn that "the evidence is overwhelming that the training that our engineering schools have given does not adequately equip a man to handle so-called 'human engineering' ". Indeed, the term 'human engineering' contravenes the spirit that should inspire any effort to deal justly and fairly with employees. It has been said that the engineer takes pains to learn how to handle the materials used in his work, yet he ignores the need for learning how to handle the basic material of industry, the men themselves. We do not like this way of looking at the problem. The engineer must learn first of all that men are not insensate material like rock or timber; he must have a regard for those imponderables that count for so much in the relations of men to each other. The distinction between the physical and the human factors must be realized, as Mr. Lewisohn says, and he quotes Mr. C. V. Corliss approvingly on this phase of the subject. "We have not yet come to the point where human reactions can be weighed and measured." As a remedy, Mr. Lewisohn suggests that the trustees of technical schools plan their curricula so as to include special instruction "in social economics and the modern technique of handling labor", and follow this with practice-work in the summer vacation, whereby engineering students will be given a chance to work "in industry with the men they will handle in their future careers". That suggests at once the need for a careful choice of instructors, not only economists and sociologists, but men who have had experience in handling men successfully. Some of them have done it well without being able to analyze or describe their own methods, but there are others sufficiently introspective and analytical to be able to give valuable hints to the younger generation. Such men would be worth many books on the subject. Some of them have had but little instruction of an academic sort, but they are schooled in experience and have the ingrained sagacity that comes of an understanding of the most difficult subject in the world—mankind. It may be objected that no academic teaching on such matters is worth much, but, as Mr. Lewisohn says, it will serve to awaken the student's interest and stimulate him to inquire into the technique of the subject. There is a technique; it is a branch of psychology on the one hand and of ethics on the other; and the man versed in it, backed by a kindly disposition and intellectual honesty, can exert a personal influence that is priceless. There is plenty of scope for it, and plenty of opposition; for the professional leaders of the labor-unions do not like experiments of this kind because they "impair the very incentives that hold their national organizations together". So says Mr. Lewisohn. Undoubtedly to the 'walking delegate' type such efforts to mitigate class enmity are anathema. If they succeed his occupation is gone. That is a consummation devoutly to be wished. What is intensely desirable is that the moderate and reasonable elements on the side of capital and the similar elements on the side of labor should find each other, shake hands, and unite in a sincere effort to establish a code of fair dealing between manager and workmen, a

code in which patronage will have no more place than truculence, and in which the head and the heart will be conjoined to promote the square deal—the democratic ideal.

The Oil-Shale Industry

So much has been said of late concerning the depletion of our national supplies of oil, so many warnings have been issued in official quarters against the present extravagant use of fuel-oil, and so insistent has been the propaganda in favor of the exploitation of our Western shale deposits, that a book on 'The Oil-Shale Industry' is sure to be welcomed at this time. The author is Dr. Victor C. Alderson, who, as President of the Colorado School of Mines, has been under fire. We believe much of the criticism directed against him in that capacity is fully justified, but that does not diminish the possible value of his writing on such a subject as the exploitation of oil-shale. Dr. Alderson is a graduate of Harvard, a clever and well-informed man, therefore we set aside any prejudice, as our readers will do also, we believe, when welcoming a book on a subject of such timely interest. An oil-shale industry cannot be said as yet to exist in the United States, but many small beginnings have been made and the prospects are good for such a development of productive activity as will lead to the actual establishment of a real 'industry'. In its primary stage this branch of mining and chemistry must go through many troubles and disappointments, not because technical difficulties are inherent but because man is prone to err and optimistic promoters are likely to lead simple people into foolishness. One can be much less optimistic than Dr. Alderson and yet appreciate the large quantity of useful data contained in his book; moreover, one may demur to some of his statements and yet feel grateful for the pains he has taken to collect reliable information from so many sources. He announces "the birth of a new industry"; he heralds the dawn of a new era; he proclaims our "well-nigh inexhaustible supply of oil-shale" as the future source of the oil upon which "modern civilization" depends. The statistics indicating the increasing consumption of oil, the depletion of oil-wells, the expansion of automobile manufacture, the insistent demand for oil in various directions, are impressive. He starts well by making the reader realize the importance of the subject he is about to discuss. Then comes a sketch of the nature, origin, and distribution of oil-shale. It contains no oil as such. Oil-shale is mud containing organic matter that has been consolidated into rock, from which petroleum may be extracted by chemical processes. In oil-sand, the objective of an oil-well, the oil is contained in the sand as oil, so that when penetrated by a drill-hole it gushes or can be pumped. In shale the ingredients of oil are undifferentiated; the oil is not separated from the shale until it is subjected to destructive distillation. 'Kerogen' is the name given by the Scots to the organic compounds that produce the petroleum. In Scotland the utilization of oil-shale as a source of oil began in 1850; and it began in France even earlier. In Australia the exploitation of oil-shale in the Blue Mountains of New South Wales was started in 1865, and a good deal of money has been spent, without much success, however. In the United States oil was won from shale by the Mormons in Utah as early as 1855, but the American supply of well-oil was so abundant and so cheap that the production of oil from rock proved unattractive. Ten years ago the subject was discussed publicly in this country by scientific men, Mr. Ralph Arnold among them, and in 1911 the first claims were located under the placer law. Since then the U. S. Geological Survey has investigated the distribution of shale in the West and has conducted experiments in distillation. Many valuable bulletins on the subject have been issued. Dr. Alderson gives an admirable account of these early researches and industrial adventures. In Scotland the richer shale yielded from 30 to 40 gallons of oil per ton of shale. At the present time a yield of 15 gallons per ton is said to be profitable, but the author's data on this phase of the subject are unsafe. He gives figures for 1909, when the total cost of mining shale and manufacturing oil in Scotland is said to have been $2.06 per ton and the net profit 83 cents per ton; but much has happened since 1909, more particularly the increased cost of labor and supplies. Later statistics are needed, if they are to be any sort of guide to American operators. However, both the Scottish deposits and the Scottish methods are supposed to be inferior to those of Colorado, Wyoming, and Utah. In the Utah portion of the Uintah basin there are 40 billion tons of shale that will yield "more than a barrel of oil to the ton", says Dr. Alderson. A barrel is 42 gallons; so that the estimated yield for this enormous tonnage is nearly three times the winning made in Scotland. In Colorado, says our author, there is 2500 square miles of oil-shale. Estimating a thickness of only 12 feet, and assuming that 25% of the rock will be left as pillars, and "counting only on 42 gallons to the ton", there is 1,012,500,000 barrels of crude oil in the Parachute region of the Grand Valley in Colorado. These figures are convincing only in proportion to their accuracy. The book contains many handsome photographs showing "mountains" of shale. These are likewise impressive, on the supposition that they consist of oil-bearing rock. They do not; they contain a layer or layers of oil-shale only, they are not the stupendous masses of valuable material that their titles suggest. This is symptomatic of oil-shale propaganda, we fear. In our eagerness to ascertain the economic value of these deposits, we skim the chapters on 'Mining', 'Retorting and Reduction', and 'Experimental Work', in order to get at the chapter on 'Economic Factors'. There we are told that the cost of "building and equipping a shale plant will run from $1000 to $2000 per ton of shale handled". The margin is too generous. A plant having a capacity of 400 tons daily, treating shale that produces a barrel of oil per ton, would produce crude oil at a cost of $1.85 per ton of shale, or per barrel of oil. So says the author. He puts the cost of mining at $1.25. This provokes scepti-

cism, as viewed from experience in coal mining. In 1918, according to the U. S. Geological Survey, the output of coal in Colorado was 3.36 tons per man. "In Scotland", says our author, "two men working together produce 8 tons per day at a cost of $1.25 per ton. . . . Certainly the American miner in our shale beds so easily mined can produce twice that amount". In Utah the cost of run-of-mine coal at the mine is $3.65; in Colorado it is $2.75 to $3.25 per ton. It is assumed, by Dr. Alderson, and by others, that the steam-shovel can be used advantageously in shale deposits; but this is unlikely except in a few favored localities. Shale has not the 'cleat', or cleavage perpendicular to the bedding, that helps so much in coal mining; on the contrary, the drill-holes blasted in shale have a tendency to 'bootleg', that is, explode a thin layer. Moreover, shale is harder to drill than coal; it is a particularly tough rock. These are matters upon which reliable information should be available, enough mining in shale having been done to furnish the requisite data. We hope some of our readers will supply them for publication. Dr. Alderson estimates the cost of retorting at 35 cents; we question whether he has allowed sufficiently for the expense of maintenance. The "amortization, interest, and overhead expenses" at 10 cents are certainly under-stated; this item will be nearer 50 cents, assuming an investment of $3.50 per ton of annual capacity. On the other hand, crude well-oil in Wyoming is quoted at $2.50 and in the Mid-Continental field at $3.15, so that a handsome competitive margin is assured, says our author. The quality of shale-oil, it is claimed, is superior to that from the wells. The minimum capacity of a retorting plant should be 100 tons, to cost $100,000. "Additional 100-ton units could be installed for $50,000 each." The minimum size of refinery should yield 400 barrels daily and cost $350,000. "This also should be regarded as only a starter." The author says that "an investment of $500,000 is as small as can be safely counted upon to make a single project successful"; evidently he has made scant allowance for the purchase of claims, the opening up of the mine, and the building of a crushing plant. On these matters likewise actual figures, not guesses, should be forthcoming shortly. The tone of the book is indicated by the "opinions" quoted in the last chapter; the author has selected the most optimistic; he ignores those that are less roseate, and in his estimates of yields he sets aside the results of tests made by the U. S. Geological Survey in favor of larger yields based upon the high results from a few tests made by private persons, engaged presumably in the promotion of oil-shale schemes. Throughout the book he assumes the normal yield of Colorado shale at 42 gallons per ton, whereas the figures he himself quotes from the U. S. Geological Survey's bulletins show an average of less than half the barrel, of 42 gallons, of oil per ton of shale. These official results, we may add, correspond closely with those of 300 samples that have been analyzed by private parties known to us. In Utah the Survey gives an average of 2.7 gallons on 83 distillation tests. On page 82 the average yield of the brown shale in the Parachute Creek district is stated to be 67 gallons per ton. Neither the Survey men nor an independent expert were able to find any shale of such quality in minable thickness; their estimate is just about one-half that based upon the seven samples quoted by Dr. Alderson, on the authority of Mr. J. B. Jones, of Kansas City. In truth, this budding industry, like many others, is endangered by a careless optimism. For instance, Dr. David T. Day in the 'Review of Reviews', contrasting the 'bringing in' of a gusher with the winning of oil from shale, indulges in the following rhetorical confectionery: "Contrast the excitement, the thrill of such sudden richness, with the comparatively tame and stable mining and manufacturing industry by which oil-shale is excavated with a steam-shovel, crushed and thrown into a retort, which slowly, but steadily, yields a stream of oil that can be safely estimated many years in advance, without excitement or speculative risk—an industry which goes forward day and night, regularly, and with nothing to interest the speculator". This assuredly is a gay counting of chickens before they are hatched. When oil-shale mining ceases to "interest the speculator" and becomes the dreary manufacturing process painted by Dr. Day's imagination, it will be the Greek kalends and we shall all go on a perpetual joy-ride. Dr. Day expects to produce shale-oil for less than 50 cents per barrel where conditions are favorable, and for not more than $1.25 elsewhere. He quotes "the best contractors" as "willing to quarry and crush oil-shale, to the degree suitable for retorting, at a total cost of not to exceed 40 cents per ton, and many venture an estimate of 18 cents per ton". He expects to retort the shale at a cost of 10 to 25 cents per ton. None of this is convincing. A number of shale enterprises are actually in operation, what are their costs? A few real figures are worth a bushel of these cheerful guesses as proferred by gentlemen evidently engaged in the promotion of schemes. What is needed is up-to-date information from engineers actually in charge of shale operations. The subject is worthy of something better than the nebulosities of Messrs. Alderson and Day; it is worthy of scientific treatment. Here we may remark that those engaged in the well-oil industry seem slow to avail themselves of the chances afforded by the deposits of oil-shale. Dr. Day says that this lack of interest is due to the fact that "no oil-producing concern is anxious to increase the oil-supply greatly and thereby disturb market conditions". Tell that to the marines, or whoever now may be the symbol of gullibility! Those directing the existing oil industry have had men in the field investigating the possibilities of exploiting the oil-shale and if they have turned a cold shoulder to the rhapsodies of Dr. Day and others it is only because they are aware of the facts, which are that oil-shale can be benefitiated profitably under favorable conditions, but that the promoting propaganda now being published is vitiated by an under-statement of cost, and an over-statement of yield, and an expectation of by-products that cannot be won in the present state of the art of oil-refining.

MEXICAN MINERS AT WORK

The Mexicans: Who and What They Are

By An Occasional Contributor

In considering the Mexican question attention must be given to the history and recent racial development of the Mexican people. Constant use of the terms Spanish-America and Latin-America tends to foster the current idea that the Mexican of today bears about the same relation to Spain as the New Englander of the last generation did to England.

Although there is an element of truth in this general belief, the real situation is far different. The fact is, Mexico is not, and never has been, a democracy; it is an oligarchic despotism, more or less feudal in character, masquerading as a republic, and the people are of a race differing, not only from our own but also from the Spanish, in the very fundamentals of their nature. In making this statement I am not referring to the question of mental superiority but to their ideas, ideals, and their mode of thinking, for the average Anglo-Saxon usually requires years of experience to understand them, and some never succeed.

This may be exemplified in the following way: if we consider any ordinary every-day American as influenced by a given set of circumstances, we can predict fairly well what course of action he will take and if he follows one different from that expected we will understand the motives that influenced him, and judge his character accordingly. In the case of the Mexican the average Anglo-Saxon fails utterly, and in the reverse the Mexican succeeds little or no better. The average American going into Mexico judges the country and the people by his Anglo-Saxon standards (which are by no means the standards of the country), and consequently makes many mistakes. The result is that he is looked upon with contempt by the natives (in their turn judging him by their standards) as ignorant and incapable.

This inability to understand the Mexican is nowhere more clearly shown than by our own government. The Mexican is temperamental, but he is just as much influenced by a plea in the name of the 'square deal' (square deal is a much more accurate translation of *justicia* than the dictionary word 'justice') as is the American, but his ideas of a square deal are based on principles fundamentally differing from our own and the attempt to judge one system by the standards of the other is not a success.

Many of the books and magazine articles on Mexico have been written after a few weeks trip through the larger cities by people with only a superficial knowledge of the country and are the object of derision to the Mexicans in general, and much regretted by Americans who know Mexico, as well as by Mexicans who know the United States. Many Americans still wax hot under the collar about the views of the United States held by Dickens and Kipling, yet these were geniuses, whereas the ordinary magazine writer is not a genius, nor is he able to understand the mind of a foreign people after a short visit among them.

The reason for this difference in standards lies in the fact that the population of the country is primarily Indian, although there are Spanish and Negro elements and even a slight admixture of Asiatics. In investigating the subject the first thing noticed is the paucity of data and next the inaccuracy of those which are available. Recent census figures are not reliable for a number of reasons some of which will appear from a consideration of the older statistics, but especially because they ignore certain important points. In 1793 Revilla Gigedo, then viceroy of Mexico, attempted a census and did obtain certain figures that have considerable value. Later, about 1808, Navarro, who was at the head of that branch of the government charged with such duties, and, independently, Alexander Humboldt revised the figures, bringing them up to date. From these data the following approximations are obtained as representing the population of Mexico in the year 1808.

Indians	3,676,000
Mestizos	829,000
Mulatos and Zambos	500,000
Negroes	6,000
European Spaniards	15,000
Whites	1,097,000
Total	6,123,000

An explanation of both terms and figures is necessary properly to understand this statement. Under Spanish rule, that is, up to the revolution of 1811-1821, governmental positions, with a few exceptions, were held only by Spaniards of European birth. Presumably equal, but actually next, in rank both socially and legally came the whites (*criollos*), then the castes (*castas*), that is mestizos, mulatos, and zambos, and finally the Indians and Negroes. These classifications carried definite legal rights and obligations as well as social and civil rank. 'Mestizo' was the general term applied to the offspring of Spaniard and Indian, 'mulato' for that of Spaniard and Negro, and 'zambo' for the Negro-Indian union. There was an elaborate technical terminology comprising some thirty or forty names to specify the exact nature and degree of the cross; thus there would be one term if the father was Spanish and the mother Indian and another if the mother was Spanish and the father Indian. A 'quinteron' was a person having one-eighth Indian blood and the remainder Spanish. The child of a Spaniard and a 'quinterona' was legally 'white'.

The term 'creole' (*criollo*) was used to denote persons born in Mexico of pure white parentage, either creole or European-Spanish. The term was not supposed to be applied to those of mixed blood, as it is in this country, but in spite of that it was used by the European-born Spaniards in a somewhat slighting way. The creoles preferred the term 'white', which was considered one of honor and respect, although Humboldt mentions that in his time they preferred the term 'American' (americanos).

It is to be noted that the two terms 'white' and 'American', used by us to distinguish the inhabitants of the United States from Mexicans, were formerly used with pride by the Mexicans to distinguish those of the highest social standing. Nor has this wholly disappeared. To an inhabitant of Spanish-America a citizen of the United States is a 'North-American' or, less politely, a *yanqui*, and I recall that a few years ago I was told by a Mexican creole: "The trouble with many Americans is that they forget there are many white Mexicans." In their own records they class themselves as 'white'; and the real trouble is that the *norte-americano* does not differentiate between the various classes.

There was a sharp distinction between the civil and social rights of whites and those of mixed blood, much to the advantage of the former. Those who had more than seven-eighths white blood were entitled to call themselves 'white', so also were the children of the *conquistadores* and certain privileged Indians. The child of a Spaniard and a woman whose father was Spanish, and whose mother's race was unknown, was also 'white', so naturally the genealogy of many an Indian grandmother got lost. The result was that all who dared to do so called themselves 'white' and many mestizos and Indians obtained legal permission to do so, the formula being, "Let them consider themselves white" (*Que se tengan por blancos*). Humboldt says that every person in Durango claimed to be white and elsewhere I have seen it stated that in Sonora only 251 paid the tax due from all except whites. This was absurd on the face of it.

The number of whites given in the census as 1,097,000 was therefore a gross exaggeration. In 1860 the number of Spaniards of European birth in Mexico was supposed to be about 10,000 and in Navarro's estimate, immediately before the revolution against Spain, it was 15,000. Revilla Gigedo's figures were 7904 in 1793, of which 2335 were in Mexico City, but of these only 217 were women. Bancroft explains the small number of women by saying that, owing to the hardships encountered, very few Spanish women came to Mexico. Where then was there any opportunity for breeding a million pure-blooded whites? Practically, the term 'white' as used today means any one who is not pure Indian or Negro.

Another thing to be noted is the amount of Negro blood. The figures given are not exaggerated; indeed, they indicate a rapid absorption of a still greater number. Cortez was authorized to import Negro slaves, one of the first licenses being for one lot of 4000. In 1635 Thomas Gage mentions the large number of mulatos and the wealth displayed by the mulato women of Mexico City. As an example of the large numbers throughout the country, he says that on the ranch of the Dominican fathers near Puebla there were "200 negroes, and women and children besides". About the middle of the 18th century Garcia Palaez made an estimate quoted by William Bollaert as follows:

Whites	450,000
Indians	1,350,000
Negroes	500,000
Mestizos	1,500,000
Mulatos	600,000
Zambos	300,000

He adds that it is probable the number of Indians includes only those paying the tribute. Note that there were more Negroes than whites.

About that time the Government set itself against the slave traffic, so that the figures of Navarro show the effective absorption during the next sixty years. During the last hundred years this absorption has become complete, so that the Negro, mulato, and zambo have disappeared.

Today the population of Mexico is probably about 14,000,000, of whom some 6,000,000 are more or less pure-blooded Indians, still speaking their own languages, the remainder being of white and mixed blood. I believe the census shows over two million whites, but one of the enumerators told me that the figures are of little value. The classification 'white' rests on the individual's own statement, which is biased. My own opinion is that the number of genuine pure whites is less than 2% of the total.

A BULL-FIGHTER

The Indian forms the greatly predominating portion of the mixture. When Cortez discovered the country he found it inhabited by a large number of independent tribes, speaking different languages. Most of these tribes may still be identified; Mexican ethnologists have traced and classified about 700 of them, although the dividing lines are now blurred, and in many cases have disappeared, but all of them, with the probable exception of the Otomis and Seris, are of the same racial stock. These 700 tribes are classified according to language into the following groups:

Apache (Athapascan)	
Zapotec	600,000
Yuman	
Huavan	
Otomian	700,000
Mayan	400,000
Nahuan	
Piman	
Shoshone	
Aztec	1,700,000
Totonac	
Tarascan	
Zoquian	
Serian	200

The figures are from estimates made several years ago by the U. S. Bureau of Ethnology and are probably much too low at the present time, especially the Mayan. The blanks in the table are caused by lack of data at the time of writing.

A 'SPORT'

The close relationship between these races and the Indians of our own country is shown by the names in the list. The Navajos, Zunis, and similar tribes are just as closely related. There is a Navajoa tribe in Sonora that makes, or did a few years ago, fine blankets of the Navajo type, and I believe the similarity in name and occupation is more than a coincidence. It will be noted that the Yaqui tribe, of which so much is read in the newspapers, does not appear in the above list. The reason is

that it is simply a branch of the Nahuan. The Seris are included in spite of their small number because they seem to be the remnant of an aboriginal people, their language being distinct from all others. They are the inhabitants of Tiburon island, which, every few years, is discovered and explored by a few daring adventurers, at the risk of their lives and a few columns of print. Any person desirous of being the first white man to tread the soil of that unknown land is hereby referred to the reports of the Bureau of Ethnology, written about 25 years ago, in which he can find full directions, including maps of the island, mode of reaching it, sources of food and water, and all other necessary information, including photographs of the islanders and the interiors of some of their dwellings.

Some of the other well-known tribes whose names will be recognized are the Papagos, Oputos, Tarahumares, Tepehuanes, Huastecas, and Tlascalans.

At the time of the conquest Mexico, like all Gaul, was divided into three parts, northern, central, and southern. Northern Mexico comprised everything north of what is now Aguas Calientes. The district is mountainous or sterile, except the coastal region and a few well-watered valleys. It was inhabited by various Indian tribes of the same race and stage of development as those of the western and south-western part of the United States. These tribes were completely independent and were classed by the Aztecs under a general term meaning 'the barbarians'.

Southern Mexico was held by the Mayas, the remnant of a once powerful nation which had apparently ruled the whole country from the tropic of Cancer to the isthmus of Panama in some former epoch, but had degenerated as the result of epidemics and internal dissensions. Their holdings were mainly tropical. From personal observation of some of the Mexican antiquities, I believe that there was a definite relation between the Mayas and the Egyptians of the early dynasties, long before the Christian era.

Central Mexico was dominated by the Aztecs, but there were still independent tribes and warfare was constant. The Aztecs, Zapotecs, and Mayas were far ahead of the remainder in the scale of civilization, but much below what Prescott would have one believe. Their land was partly tropical valleys and partly temperate tablelands.

There is no reliable information available as to the population of the country at that time, but after reading the various recorded guesses and seeing the country and people of today, and some of the remains of the former civilization I would say that five to seven million would be a fair estimate, although evidence can be adduced that it could not have reached four millions, and other testimony, equally strong, indicates that it may have exceeded 12 millions. If I had to choose between these two estimates, I would prefer the smaller.

History apparently records no religion so fierce and so bloody as that of the Aztecs. Clavigero quotes authorities to the effect that in the coronation-year, alone, of Ahuitzotl, the number of human sacrifices reached the awful total of 72,000 and that the average number per annum in Mexico City alone was 20,000. These figures are undoubtedly exaggerations, but equally undoubtedly the real number must have been very large.

In addition to this there was religious cannibalism, that is, the bodies of the victims were eaten according to prescribed ceremonial. Cortez in his official dispatches to the King of Spain says: "Thus by means of the ambuscade more than 1500 of the enemy were slain and that night our allies were well supplied for their supper as they took the bodies of the slain and cut them up for food". (Folsom's translation, 1843 edition.)

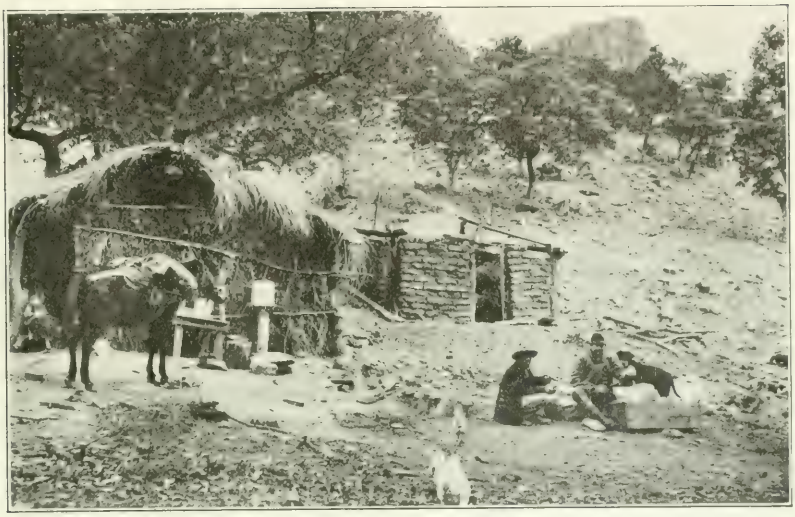
The numerous wars were largely for the purpose of obtaining victims, the main object of the Aztec warrior being not to kill but to capture his enemy alive for subsequent use as a sacrificial offering, the subjugation of the neighboring tribes being only of secondary consideration with the Aztec rulers. This kept up a continual state of war and it was by taking advantage of the tribal hatreds thus engendered that Cortez conquered, rather than by force of arms.

It was this Aztec-Zapotec civilization that was dominant in Mexico, and it is to be remembered that the descendants of these Indians are prominent in Mexican affairs of today, and that until about fifty years ago there was no attempt made to educate them. In vice-regal days the clergy as far as possible destroyed all knowledge of the Indian civilization and the secular government prohibited their education in the white man's standards.

Their social system was distinctly feudal. The Emperor, so-called, was a great feudal lord (*cacique*) who was supported by tributary caciques and so on down the scale, the smaller ones having only a few retainers, perhaps only the members of their own family. The family was the unit, not the individual, the individual being always dependent upon some chief or greater chief to whom he rendered obedience, tribute, and support, and by whom he was protected. The relationship was one of mutual service, not slavery; it was patriarchal in nature, although leadership did not necessarily pass from father to son. Land could be held by individuals, but was mainly held in common, and one of the reasons for Zapatism is the demand for the return of the community-property belonging to the villages.

In the north-eastern part of the State of Puebla there is a remnant of the Aztec tribe, off the beaten track and comparatively little affected by the outside world. They still speak the old Aztec tongue and are ruled by their own customs rather than Mexican law. The villages hold community-land and the families hold their land in common. Half-breeds are not allowed to take part in tribal affairs. If anyone desires to employ a few laborers, the correct way is to send word to the chief, who will dispatch an available sub-chief controlling the requisite numbers. Under the guise of saints'-days they still celebrate the old and easily recognizable corn and sun dances, and it is even hinted that in the mountains they celebrate other old rites, not so harmless.

This, then, is where the fundamental difference between the American and Mexican comes in. The Anglo-Saxon is fundamentally individualistic and democratic,



AN INDIAN CAMP

A GROUP OF REVOLUTIONISTS, SUPPORTERS OF MADERO

and always has been in spite of feudal branches grafted on the democratic stock. The Mexican, on the other hand, belongs fundamentally to a feudal patriarchal system, even to the extent of recognizing the justice of vicarious punishment.

The second difference is the regard for human life. It is not to be believed that the bloody customs of the old Aztec religion are without effect on the character of the Mexican of today. He shows no hesitancy in killing if circumstances seem to him to require it.

These native characteristics were developed and strengthened by the conquest. The Spanish government, basing its action on the theory that the Indians were barbarians requiring care and protection, decided that in recognition of public services certain Spaniards should be given the government of a village or tribe of Indians, as the case might be. In accord with the spirit of the times, they were to be allowed to levy a tax, either in produce or services, to pay the expenses of the Government and to provide a suitable salary for the Governor. These were the *encomiendas*; they were hereditary, and supposed to indicate the establishment of a feudal system. In practice, the Indians became slaves. Las Casas gives a terrible picture of the decrease in population resulting from the Spanish rule and, although his figures are undoubtedly exaggerated, the entire disappearance of the aboriginal population of Cuba and Santo Domingo is proof enough of the evil results. To stop this, slaves from Africa were introduced into the country, and slavery was not abolished until the revolution commencing in 1811, but, be it noted, slavery was abolished fifty years earlier than in the United States. The theory of government in Mexico during the Spanish rule was ahead of the times even if the practice was far behind.

After the conquest the Spaniards at once attempted to take possession of northern Mexico, and sent out colonies consisting mainly of allies, usually Tlascalans, with a few Spaniards in charge, to settle the country, but they were necessarily few and widely scattered. The conditions in the extreme South was somewhat similar. In the attempt to rule this vast domain, much of which was sparsely settled, it is not surprising that revolts and raids ensued. Some tribes never did yield until within comparatively recent years. The Mayas, I believe, did not consider themselves as part of Mexico until a treaty was made within the last fifteen years. It has been said that the only years of peace in the four hundred since the conquest were those during the administration of Diaz.

Northern Mexico is dry and unproductive; the land must be worked in large units with expensive irrigation in order to be profitable. Except in a few favored spots 'forty acres and a mule' are of no value at all. Naturally the small farmer could neither develop a farm nor protect it from Indian raids and bandits when established. As a result it is that agriculture was mainly in the hands of the [illegible] who operated large ranches with walled fortress-like haciendas to protect their families and dependents. Many still remain with their loopholed towers [illegible] and a little village within. The [illegible] so stand alone, so the combination of the feudal and patriarchal systems persisted. Then came the revolution of 1811 and the wiping out of class distinctions, but it could not wipe out the material conditions, nor the heritage of blood and feudalism.

This is a rough outline of the background of the present Mexican status. What then, is the Mexican of today? Taken as a whole he may be said to be a cross consisting of about 83% Indian, 12% Spanish, and 5% Negro, with a strong trace of Asiatic, but the melting process is by no means complete nor is it uniform. In northern Mexico, for example, the mining engineer in the mountains who employs a lot of peons probably has a group that is 95% or more Indian. Villa's forces, excluding adventurers from outside, are probably 90% of the same race as that cooped up on the Navajo, Apache, and Pima reservations. On the other hand, the manufacturer in the city is likely to have a force that is 15 to 20% white blood. In Yucatan, or Oaxaca, or Chiapas, the peons may be pure Indian.

The percentage of white blood increases with rank in the social scale until in a few families it is pure, although I believe this to be true in less than 10% of the cases so reported in the last census, otherwise the early Spanish women must have been extraordinarily prolific. Practically never will a man with predominating white blood be found among the peons. On the other hand, men with pure or predominating Indian blood do often appear among the most important men of the country. Juarez was a Zapotec, so were Diaz and Huerta; and there is absolutely no question about the ability of the first two, at least. Humboldt mentions an Indian millionaire over a hundred years ago. The large number of Zapotecs and Tarascans in public life is proverbial. The great ranch-owners are frequently white though more often there is a trace of color, since marriage with those of mixed blood is not regarded as it was before the revolution against Spain.

The peon, in the mass, therefore may be said to have at least 90% Indian blood, 6% Spanish, and 4% Negro, most of the latter being in the peons of Vera Cruz, Puebla, and other central and southern States. He is superstitious, ignorant, thoughtless, and improvident, kind but easily excited, and then cruel both to people and animals, usually insufficiently nourished, and possessed of a well developed love for the *tierra*, with strong family and tribal loyalty. He is a faithful and steady worker under a just and strong boss who understands him, but lazy and worthless under a weak or unjust supervisor. When properly instructed, well fed, and well managed, he is an efficient worker and a good artisan, and soon identifies himself with the family or concern for which he works. His mentality is low, but how much of that is due to lack of education, insufficient and improper food, and disease, I am not prepared to say—certainly a great deal.

It is a common saying that the Mexicans are thieves—and they are; but the statement must be greatly modified because in some ways and under some circumstances they are thoroughly honest and trustworthy. As an example of the working of the peon mind, I mention Romolo. I

was in a small mining camp and had engaged Romolo as a servant. His duties were to look after my room, do the marketing, milk the cow, and attend to the usual odds and ends. One day I went away for the week-end and on my return was told that every house in camp had been robbed. I hurried to my room and found, as expected, that everything of value was gone. Romolo showed up in due season and I told him that the thieves had taken all my belongings. "No, Señor," said Romolo, "I had a hunch that there was going to be a robbery and took all your things and hid them out in the brush"; and sure enough every last one was brought back. Now that was honesty as he saw it. He could not 'tell on' the members of his circle who did the stealing, nor could he permit them to steal my things; nor did it concern him that they robbed my friends. I have known a banker to send $5000 in bills by a peon on a ten-days tramp over the mountains alone and the peon's wages were about 35 cents per day, yet the money was delivered to me in due course.

With his heritage of ignorance, feudalism, and serfdom the peon needs and expects a *patron*, and I think that it will require several generations to overcome that condition. He is not fit for democratic government as we know it and it seems that it will take at least three generations of education for him to qualify.

As a people we endorsed Madero's cry for universal suffrage in Mexico, but in our own country the Indian has been placed on reservations under the tutelage of the Government, and Indian schools have been established, yet even in these days of Bolshevism I doubt if many people can be found who would advocate giving a controlling vote to the Apache, Sioux, Navajo, Shoshone, Zuni, Moqui, and Yuma Indians, yet that would be precisely the condition in Mexico under a purely democratic government enforced in accordance with the law. I mention these particular tribes because of their direct relation in language, blood, and custom to those in Mexico.

The Spanish government attempted to rule five million Indians by keeping them in ignorance and subjection, using for the purpose a few thousand Spanish-born agents, aided by a favored class which was united as against the divided Indian tribes. The revolution of 1811 was successful against this state of affairs not because of the combining of the Indians, but because the favored class of white creoles was jealous of the authority and prestige of the Spaniard. The first ruler after the revolution was a creole, Iturbide. As soon as the Spaniards had been overcome, the creoles expected to rule the country, but their caste itself was too heterogeneous and did not hold together, owing to the presence of strong mestizo and Indian elements. The situation was somewhat as it would be in the Southern States if there were seven blacks for every white man and a few favored blacks and mulatos were classified as white. It must be remembered, first and last, that the Spaniards never did control the whole country. Indian raids and robberies were numerous, particularly in the northern part, and banditry was common even in the parts that the Government did control. After the break-up of the Spanish government and the failure of co-operation and unity among the whites, one party after another seized the power, but was never strong enough to accomplish anything definite. Lempriere, writing in 1859, says: "In 38 years the country has had 36 different forms of government and 72 individuals have figured as chief executives."

Mme. Calderon de la Barca, writing during the early years of this period, mentions the necessity for armed escorts with the stages and of having had prominent bandits pointed out to her on the city streets. She describes a Governor's ball and mentions that the gentlemen put on their pistols, as a matter of course, before leaving. Lempriere, in 1862, says, "Life is utterly insecure in Sonora, Sinaloa, Chihuahua, Coahuila, Durango, etc",

A ROPE-MAKER

and "the ransom system is coming more and more in vogue . . . The murderers of Yorke, the young American attaché, are perfectly well ascertained citizens resident in Tepyahualco . . . The civil power has no force . . . Mr. Mathew's residence in Mexico was forcibly taken possession of on the 16th of November, 1860, by General Lagarde under a pretence, the falsehood and absurdity of which must be notorious, that a deposit of arms was concealed." "A force of twenty men made a descent on the house of Mr. Beale . . . They told him he was a foreigner and as such their enemy, and fell upon him and literally cut him to pieces." "Two of the public stages arrived in this city with the passengers stark naked." "The army is a nursery for highwaymen." "The lists of claims for outrages on British subjects pre-

sent such a frightful catalogue of murder and robbery that, except vouched for on the most solemn and sure grounds, would be incredible. . . . Some small show of inquiry, and incessant persecution of witnesses, and never-ending expenses, ending in a mockery of investigation and total impunity of crime, are generally the utmost attained." In another place: "Usually after all his trouble and expense [the injured party] has to pay the prisoner a sum of money to compromise an attack on his [the prisoner's] unblemished character".*

This sounds like an extract from one of Senator Fall's speeches. In other words, the present condition of Mexico is normal; the period of safety and industrial development under Diaz was abnormal.

After some twenty years experience in Mexico, my opinion is that Diaz was driven out as a result of the educational system he established. The Spanish viceregal system was certainly founded on the ignorance of the Indians. The Church was an essential part of the Spanish state in Mexico; after the revolution it still retained its power, and did not attempt in any way to educate the Indian except as to his duties to the Church. The school as a means of secular education dates practically from the time of Diaz, and while the system of public schools which he established was far from what is considered ideal in the United States it was a vast improvement over anything preceding it. By 1910 a generation had arisen that knew the rights to which they were entitled under the law, but still did not know how to use those rights with discretion, and failing to obtain them because of their neglect to observe at the same time the maxim of Juarez, "Peace is the due regard for the rights of others", caused the downfall of the Diaz administration. If Diaz could have had his health and strength for twenty years longer, I believe Mexico would have attained a well-established liberal government in peace and quiet. In 1910 practically all the young men of city and town could read and write, but during the last few years most of the schools have been closed except in the larger cities. Children who were of school age in 1910 must now work to earn a living and the generation now growing up knows nothing but revolutions and their attendant troubles.

Those who state that there never was an honest election in the time of Diaz are perfectly correct. There never has been one in Mexico. Madero's election was a farce and Carranza's rested on his own *ipse dixit*, but, by the same token, how many elections have there been in Mississippi that have lived up to the spirit of the Fifteenth Amendment? Can South Carolina or Florida throw the first stone? How can any man in Mexico on whom the welfare of the country depends trust the election to a majority of uneducated and ignorant Indians? I do not except the recent election. That it represents the wish of the majority of those now in control of Mexican affairs, I grant; but I doubt if 2% of the population voted, and I am sure that not more than a quarter of those had the slightest idea of what they were doing. I am equally sure that if any large number had wished to vote against Obregon they would have had considerable difficulty in getting their votes counted without the usual preliminary discussion with Mauser rifles.

I give an example: In 1909 I was traveling in southwestern Chihuahua, a hundred miles or so from the nearest railroad, and stopped at a small mountain ranch to get provisions. I had already noticed throughout the country a strong feeling against Diaz, which the rancher evidently shared. He was above the average in intelligence, so I asked him why the feeling existed. His reply, freely translated, was as follows: "Well, Diaz keeps peace all over the country, but in the old times there was lots of fighting and when there was fighting (*guerra*) the pickings were good". This sounds to me a good deal like Bolshevism, but he was one of the voters for whom Madero was crying "universal suffrage". Any government in Mexico must reckon with this condition.

Prior to the coming of the Spaniards there was no government of Mexico as such, because, as previously stated, the country was inhabited by a considerable number of independent Indian nations. After the conquest the history of the government may be divided into three periods:

The first period, from the conquest until the end of the revolution against Spain in 1821, consisted of the government of a number of subjugated Indian tribes by a few thousand agents of the conquering nation. This period was marked by the education of the dominant race only, and the form of government failed because the favored class finally recognized its own power and seized the government for itself.

The second period lasted until the French intervention in 1862. In this case a ruling white caste attempted to govern a large mixed caste and a number of more or less closely related Indian tribes. There was education of the dominant groups only. The system failed because of a lack of solidarity in the ruling caste and its failure to recognize the nature and strength of the subordinate castes. It is to be noted that two of the important leaders who overthrew it were pure-blooded Indians.

From 1862 to 1867 there was an interregnum, due to an attempt to re-establish a combination of the first two systems by aid of the French. It failed, because it possessed the bad points of both.

The third period, from 1867 to the fall of Diaz, represented the governing of a number of Indian races by a ruling caste, consisting of a dominant clique mainly of the white race, and a subordinate larger group mainly of mixed blood, membership being dependent on money, education, or political control. This period was marked by an attempt to establish general education. It failed because of insufficient recognition of the power of the awakening subordinate caste, which had not yet acquired sufficient knowledge to use its power justly or harmoniously.

The year 1911 was marked by an ill-judged attempt to establish a government of the people by universal suffrage. It was a complete failure, because the general education was as yet insufficient to weld the heterogen-

*Mexican law permits a suit of damages against the complainant in case of acquittal.

eous elements into a unified nation. The failure has resulted in the re-establishment of the third form of government in its earliest stage. If that attempt had been postponed 20 years, I believe that revolution would not have been necessary.

The recent revolution and election introduce no new element. Obregon is a creole, that is, he is of Spanish descent, which in itself is a source of weakness. Apparently the Indians best understand the Indians and there is more than a suggestion of this truth in the fact that Juarez, Diaz, and Huerta died in their beds while Iturbide, Madero, and Carranza (creoles all) died from the common over-dose of lead. Obregon, however, has shown marked ability in handling the Indians of the North, and now that he is president and resident in Mexico City he may succeed with the Indians of the South, but there has been little love lost between the two regions and he is between the devil of jealousy if he surrounds himself with old friends and the deep sea of uncertainty if he abandons them for new ones. He has, however, shown himself able to profit by the experiences of his predecessors, and our people at Washington likewise are learning, if somewhat slowly. The death of Carranza will be forgotten, unlike that of Madero; the outlook is now the brightest it has been since Madero started his revolution; nevertheless the elements of weakness are there. Time alone will tell whether Obregon has the requisite strength and wisdom.

Once more I quote from Lempriere, who, sixty years ago, wrote:

"The merciful hand of Providence has bestowed on the Mexicans a magnificent land, abounding in resources of all kinds—a land where none ought to be poor, and where misery ought to be unknown. . . . One thing alone is wanting, that is a government—and the absence of this mars all the other magnificent advantages."

Ontario's Mining Industry in 1920

Returns received by the Ontario Department of Mines for the six months ending June 30, 1920, are tabulated below, and for purposes of comparison the quantities are given for the corresponding period in 1919. Tons throughout are short tons of 2000 lb.

Product	1920 to July 1	1919 to July 1
Gold, ounces	277,656	231,729
Silver, ounces	4,171,322	5,744,172
Platinum metals, ounces	184.45	30.08
Cobalt (metallic), pounds	113,239	59,337
Nickel (metallic), pounds	4,854,979	5,147,745
Nickel oxide, pounds	3,491,544	5,503
Cobalt oxide, pounds	388,318	202,912
Other cobalt compounds, pounds	1,417	26,289
Nickel sulphate and carbonate, pounds	159,183	133,732
Lead pig, pounds	749,820	1,481,204
Copper sulphate, pounds	89,939	.....
Copper, blister, pounds	2,918,153	3,080,492
Nickel in matte exported, tons	9,527	7,072
Copper in matte exported, tons	4,434	4,341
Iron ore exported, tons	2,189	5,804
Iron, pig, tons	28,771	24,095

During the half year 1445 tons of ore, 581 of concentrate, and 1185 tons of residue were treated in the southern Ontario refineries situated at Thorold, Deloro, and Welland for a recovery of 1,477,490 oz. of silver in addition to arsenic, metallic nickel, metallic cobalt, and compounds of these last mentioned metals. The companies operating were the Coniagas Reduction Co., Deloro Smelting & Refining Co., and Metals Chemical, Ltd. The last mentioned operated for the first three months of the year only, after which the plant was taken over by Ontario Smelters & Refiners, Ltd. Alterations in plant and process were made, which prevented production during the second quarter of the year. This new company also owns the plant at Chippawa formerly operated by the Standard Smelting & Refining Co. Copper sulphate was recovered from residues by one of the companies. Only 203,713 lb. of metallic nickel and 15,384 lb. of oxide were marketed.

During the half year 627,681 tons of nickel-copper ore was raised and 520,705 tons smelted, the total output of nickel-copper matte being 28,365 tons containing 15,030 tons of nickel and 7705 tons of copper. The British America Nickel Corporation and the International Nickel Co. of Canada worked the Murray and Creighton mines, while the Mond Nickel Co. raised ore from the Garson, Levack, Bruce, Worthington, and Victoria No. 1.

As regards shipments of matte, 7944 tons went to Canadian refineries at Port Colborne, Ontario, and Deschenes, Quebec, 16,323 tons to the United States, and 1123 tons to Wales. During the period the new electrolytic refinery at Deschenes commenced operations and had 1185 tons of matte in process on June 30, although no refined metal was ready for market at that date. The new plant which permits recovery of metals of the platinum group in pure form is reported to be working very satisfactorily as is also the smelter at Nickelton, one mile from the Murray mine, where the ore is smelted direct without preliminary roasting. In addition to metallic nickel, nickel oxide, and blister-copper, there was a by-product recovery at Port Colborne of the precious metals gold, silver, platinum, palladium, rhodium, ruthenium, osmium, and iridium. There was also a small recovery of copper in the United States from Ontario silver ores.

The entire output of pig-lead came from the mine and smelter near Galetta on the Ottawa river operated by the Kingdon Mining, Smelting & Manufacturing Co. The product was consigned to the James Robertson Co., Ltd., of Montreal, manufacturers of plumbing supplies. There is a small recovery of lead from the silver ores of Cobalt treated in the United States refineries, returns of which are received only at the end of the calendar year.

JAPAN in 1918 imported ferro-manganese to the amount of 1,697,280 lb., valued at $203,452, of which Australia furnished 1,132,800 lb. and Great Britain 564,480 lb. The principal countries to which Japanese manganese is exported are the United States, Great Britain, France, and China. In 1918 Japan's exports to these countries aggregated 5,229,864 lb., valued at $176,120, and in 1919 they amounted to 6,158,932, valued at $237,365. The present price of ferro-manganese is $200 per ton for high-grade.

Notes on Routine Assaying at the Globe & Phoenix Mine, Southern Rhodesia

By H. R. EDMANDS

*As some innovations in assay-practice have been made here, a short description of the methods adopted may be of interest.

The ore itself presents no particular difficulties; it contains stibnite, averaging perhaps 2%, and although much of the gold is fairly fine, coarse gold is also frequently present. Some 1600 to 1800 assays are made per month, and a day's run seldom much exceeds 100.

Preparation of Samples. In dealing with the samples received, the chief difficulties in getting representative portions for assay are as under:

Crushing Mine Samples Before Quartering. Just how far crushing should be carried depends, of course, on the even distribution, or otherwise, of the gold in the ore. Bearing in mind that a piece of ore 1-in. cube on being reduced to $\frac{1}{8}$-in. cubes would be divided into 512 fragments, as against only 64 if reduced to $\frac{1}{4}$-in. cubes, the importance of fine crushing at this stage is evident. Coarse rolls following a breaker would in many cases be advisable.

Segregation of Values in Fine Crushing and Screening. The more brittle or softer portions of the ore, being the first to be crushed, will be separated from the harder portions (carrying different values) by screening during crushing. A similar segregation occurs with disc-pulverizers, and very thorough mixing of the ground product is required to get accurate results.

Coarse gold will obviously cause discrepancies in duplicate assays. Some consideration of the law of averages affecting this is not without interest.

Assuming that 20-dwt. ore is dealt with, that two assay-tons are taken, and that the gold and quartz exist in spheres of equal size, then, if Poisson's law be applied it will be seen that if these spheres be 1/60 in. diam., the maximum error will be 39 dwt., and the mean error 9.2 dwt.

If spheres be 1/100 in. diam., the maximum and mean errors will be 16 dwt. and 4.5 dwt.; if 1/200 in., the errors will be 5.6 and 1.6 dwt., while 1/400-in. spheres would give maximum and mean errors of 2 dwt. and 0.56 dwt. respectively.

Doubling the amount taken for assay does not halve the error, which varies inversely as the square root of the weight of sample taken.

Although on crushing a sample to pass, say, a 60-mesh screen, the greater portion of the gold would be very much smaller, yet if the crushing is effected with frequent screening or by means of a disc-purverizer, which acts much as does a screen, the gold will not be so finely divided as it would be if the sample were crushed, say, in a ball-mill without removing any portion until the whole had attained the required degree of fineness. In the last case attrition of gold continues throughout the grinding, in the former, some of the coarser gold is removed, when it will just pass the screen or escape between the plates of the pulverizer.

More concordant results would be expected from crushing in ball-mills, and this is borne out by practice.

Ball-Mills for Sample Grinding. To eliminate as far as possible some of the sources of error alluded to, I designed a mill capable of taking the product of the breaker and reducing it at one operation to practically any degree of fineness required, this being regulated by the time of grinding and the weight of balls used.

The mills are made of cast-iron with two compartments separated by a vertical partition through the centre, perpendicular to the axis. Each compartment takes a sample of 600 or 800 gm. Its inside diameter is 11 in., each compartment being 3⅝ in. wide. Two 3-in. balls are used in each compartment. The mill is driven at 70 r.p.m. by 1½-in. belting, direct from 2-in. counter-shaft, without pulleys, and the belt runs over the centre of the mill, which is slightly crowned.

Excluding the cost of the pattern, the mills were made, at the mine, for a little under £5 each.

A timber frame of simple construction holds the mills, the bearings are of native hardwood, open at the top, so that the mills can be lifted in and out by two hooks. Each compartment of the mill is opened by one nut, and its contents emptied into a pan. It is then cleaned by compressed air. Eight such mills, taking 16 samples, are in use.

The mills are cheap, readily accessible for cleaning, and wear is inconsiderable, very much less than with disc-pulverizers; also as the wear is even, it does not affect the efficiency of the mill, which is not the case with disc pulverizers.

The final product is perfectly mixed, and, no screening being required, is ready for assay.

A 600 or 700-gm. sample that just passes a screen with ⅜-in. openings will, after 1¾ hours grinding, give a product averaging

		On	60-mesh	.....	Nil
Through	60-mesh	"	100 "	.....	0.5 "
"	100 "	"	150 "	.....	6.0 "
"	150 "			.....	93.5 "

A reduction of native labor has been made since they have been used. Assays have checked better, and, although they are slower than disc-pulverizers, their ad-

*From 'The Journal of the Chemical, Metallurgical and Mining Society of South Africa'. April 1920.

vantages outweigh this drawback, at least with this ore.

Battery-Discharge (Screen) Samples. Lime is added to promote settlement, the clear water decanted, and the thick pulp well mixed. The portion taken for assay has most of its remaining water removed by an air-pressure filter, after which it can be quickly dried. This type of filter is quicker than, and preferable to, a vacuum-filter, except when the cake requires washing, for which it is unsuitable, cracks being apt to form and cause channeling. The dried sample is ground for two hours in the ball-mill, when all passes a 100-mesh sieve, and 98% passes a 150-mesh sieve. Fine grinding is essential to get concordant results.

Reduction Samples. These do not require fine grinding, all but the finest gold having been removed by amalgamation.

Reduction samples, containing dissolved gold, are treated as follows: The dissolved gold is precipitated, usually by adding cuprous chloride dissolved in brine, to the pulp, and acidifying with sulphuric acid. The pulp is then filtered in the air-pressure filter and dried. This is not only much quicker than drying without filtration, but gives more accurate results. If the excess of barren solution be not removed by filtration, some of the gold is apt to re-dissolve on heating, and to form an enriched hard scale adhering firmly to the dish. For richer solutions I have found the error, presumably from this cause, to be quite important. In cases where much sulphocyanide is present, and precipitation by a cuprous salt is imperfect, an emulsion of finely ground charcoal should be substituted, or used in conjunction with the cuprous salt, by which perfect precipitation is obtained.

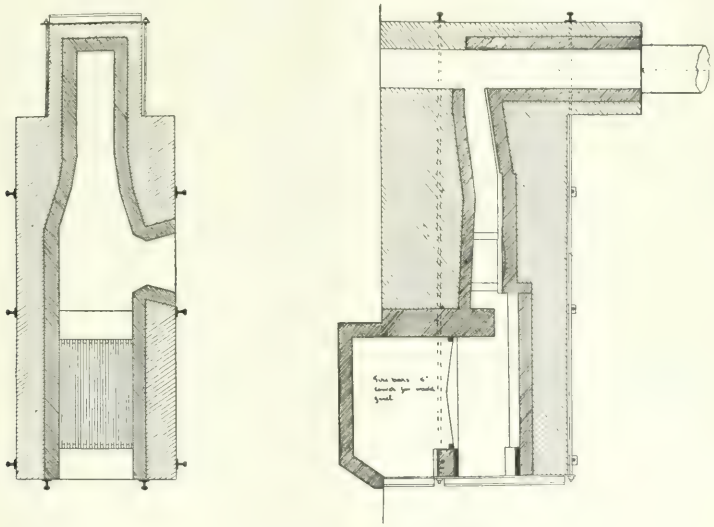
Fluxing. The substitution of fluorspar for borax, both wholly and in part, has been tried, but with unsatisfactory results.

Mixing Ore and Flux. This is effected by shaking in a large glass with a metal cover, to which is cemented soft sheet rubber. Mixing is more thorough and quicker than by the older method of rolling on glazed paper.

Assay-Furnace. The coke-fired Cornish furnaces, formerly in use, have been replaced by a reverberatory furnace shown in the diagram.

This type of furnace I previously adopted in Western Australia for burning wood, and it follows, I believe, the general lines of those used on the Rand. Wood, wood and coal, and coal alone have been used, the first being much the cheapest in Western Australia, and the last, the cheapest here.

Special features are the abrupt lowering of the top arch just behind the firebridge, deflecting the flame onto the front row of pots; the hearth is not level, but rises gently from bridge to flue, obviating the danger of pots falling backward; the hearth is covered with a layer of sand, or, preferably, of sifted earth, which absorbs any slag spilled.



REVERBERATORY ASSAY-FURNACE
Scale: 1 in. = 4 ft.

The furnace will take a charge of about 56 pots, usually 6 or 8 Js, and the remainder Gs and Fs; the heat is uniform, and the pots last considerably longer than with Cornish furnaces. During fusion the damper is nearly closed, and a somewhat reducing atmosphere is maintained.

Two charges of pots generally complete the day's work, after which the same furnace, without a muffle, is used for cupellation.

Cupellation is effected as follows: Bricks are placed on the hearth of the furnace to support wrought-iron

plates, each carrying about 25 cupels. The cupels are charged with lead buttons while they are cold. A good fire is made, and the damper opened rather more than when the pots are in. The atmosphere is reducing at first, but soon becomes oxidizing and cupellation proceeds steadily. Many checks have been made by re-cupelling prills of parted gold, but no loss of weight could be detected.

T. Kirke Rose has shown (Inst. M. & M. Bull. 174, March 13, 1919) that gold is not readily volatilized either in a reducing or an oxidizing atmosphere, and that losses are much greater when exposed to alternate reducing and oxidizing conditions. Such alternations occur here, but at an early stage when the gold is well protected by lead, which probably accounts for the absence of appreciable gold losses.

Over 100 cupels can be taken in one charge, and so far as I know, this system of cupelling without a muffle is unique in assaying. It, however, should be noted that all assays here are parted; whether it would answer as well in cases where the gold prills are weighed direct I cannot say from experience.

Cupels. For the past 12 months these have been made from old used cupels, re-ground in a ball-mill. The absorbent power of these cupels is excellent, and they are in every way satisfactory.

Cement, and mixtures of cement and mabor, were previously tried, but were not altogether satisfactory. An excellent cupel can, however, be made from a mixture of mabor and bone ash.

Parting. Perforated sheet-iron trays, each carrying 24 parting cups, and fitting over an electric hot-plate are used.

Failing an electric hot-plate, partings can be done over the hot cupels, covering the latter with a sheet of $\frac{1}{8}$-in. copper to more evenly distribute the heat. Waste acid, after precipitation of silver, is sent to the smelting house and used in cleansing bullion. The recovered silver is made into silver nitrate.

Annealing. The tray of parting-cups is allowed to rest a few seconds on a red-hot cast-iron plate of the same diameter as the hot-plate.

Solution Assays. The procedure is as follows to 20 A.T. of solution add 5 gm. of zinc-dust with vigorous stirring, then enough silver nitrate to ensure parting, and 40 cc. of 20% lead-acetate solution, again with thorough stirring. Finally add 30 cc. hydrochloric acid, cautiously, and stirr until all action ceases. Filter and scorify with a flux of 2 parts of litharge, 1 part of borax-glass, and a suitable amount of powdered glass. Nearly all the zinc is eliminated by the acid, and the remainder by scorification.

Scorification is often troublesome in a muffle, where the space is limited, but this does not apply to the hearth of a reverberatory.

This method gives accurate results on all but the most impure solutions.

Reduced Costs. Since the use, early in 1919, of a reverberatory furnace, ball-mills, air-pressure filter, etc., the total cost of assaying has shown a considerable decrease from the previous year, although more assays were made, the cost of wages and supplies rose, and the cost of new plant was included.

Note. Poisson's Law. Beringer, in the appendix to his 'Assaying', treats this rather fully. It may be formulated for the present purpose thus: Let x equal the number of gold spheres, y the quartz spheres, and z the combined number of gold and quartz spheres; then $\sqrt{\frac{8xy}{z}}$ equals limit of deviation by error in the number of gold spheres present. To find the mean error the result so obtained has been multiplied by 0.2786.

In the applications given I have calculated the number of spheres of gold and quartz in a 2 A.T. of sample, assaying 20 dwt.

If the present price for silver is maintained to the end of the current year, the total value of Cobalt's production will scarcely reach that of last year, judging from figures available at the present time. On the other hand, should the market price go higher and reach anywhere near the average for the first three or four months of 1920, there is a good chance of last year's figures being passed. With the quotations for silver around 95c., and adding to this the premium on New York funds, the price obtained at present is over $1 per ounce, and the total revenue for the Cobalt mines is in the vicinity of one million dollars monthly. Last year the silver mines produced $12,747,621 worth of metal. This sum was obtained from a little over 11,000,000 oz. For the first half of 1920 the indicated output had a value of more than six million dollars, but there is little likelihood of the second half of the year being as productive unless there is an early appreciation in the value of the metal. Conditions at the mines are on the whole satisfactory. Whereas a few months ago many miners were uneasy because of the unsettled state of the market, workers at the present time are more steady and less inclined to cast about for work elsewhere.

The cost of field operations in producing crude oil in California has increased 200% or possibly 300% during the past five years, according to statistics recently published by the State Mining Bureau. In 1915 the operating cost was generally less than 20c. per barrel while in 1919 the figure was in the neighborhood of 40c. or more. Decrease in productiveness of wells coupled with advanced cost of labor and material are the underlying reasons. The total capital invested in the oil industry is about $320,000,000 upon which dividends of $35,418,851 were paid, or at a rate of about 11%. About two-thirds of the total output of crude oil is refinable, or above a gravity of 18° Baumé. The total area of proved oil-land is 91,792 acres or 143 square miles. Upon this land there are 8928 producing wells, slightly more than 10 acres per well. Future drilling will probably increase the number of wells until the average amount of land drained by a single well will be 7 or 8 acres.

The Application of the Bradford Flotation Process to Mixed Sulphide Concentrates

By W. D. GREEN and WILLIAM FAGERGREN

History. From 1916 until April 1919 inclusive the Midvale Minerals Co. was engaged in milling the stored and current tailing from the United States Smelting Co.'s custom concentrator at Midvale, Utah. The process used was flotation, and the product made consisted of a mixed sulphide-concentrate having an approximate composition as follows: zinc 29.2%; lead 10.7%; copper 1.6%; iron 12.5%; insoluble 10.5%; silver 6.42 oz.; gold 0.08 oz. per ton. This product varied, in places containing more zinc or lead, and in places less iron. The concentrate was so low-grade that it was not possible to dispose of it to retort-smelters. However the plant operated during the War and little trouble was experienced in selling the concentrate to an electrolytic zinc refinery. When metals took their drop after the ending of the War the electrolytic refinery cut off shipments. About this time there was being tried a mechanical machine for effecting a separation of the lead from the zinc, and while there were periods when results seemed promising, operation on a paying basis was never reached, so the plant was closed down in April 1919, leaving a stock-pile of some 2000 tons of concentrate that assayed approximately as mentioned above.

Development of the Process. During the active life of the Midvale Minerals Co., one of the present writers had at various times conducted experiments in preferential flotation on the original feed to the mill, employing the several processes developed in Australia, and while results were sometimes successful there never was any consistency in the separation of the lead from the zinc. In fact, while in one experiment it was possible to effect a beautiful separation, on another sample of the same material the results could not be repeated. Results were so unsatisfactory that there was never any attempt to make use of a preferential process on a commercial scale, but every now and then duplication of the Australian work was tried in the laboratory.

About the time that the Midvale Minerals plant closed down the metallurgists for the Stimpson Equipment Co. were having some success in their laboratory in applying the Bradford process to certain ores and at their suggestion the owners of the stored concentrate authorized experimental work to be conducted on the mixed concentrates in an effort to convert them into a salable product. Accordingly work was begun by one of the writers in the Stimpson Equipment Co.'s laboratory in July 1919. The bulk of information available at that time was contained in two magazine articles, one by Edwin T. Henderson, 'The Bradford Process at Broken Hill', 'Mining and Scientific Press', September 28, 1918, and the other by Guy C. Riddell, 'Collective and Preferential Flotation', 'Chemical and Metallurgical Engineering', December 15, 1918. As the work progressed, private communications from Mr. Bradford, Mr. Wilton Shellshear, and Mr. Riddell were exceedingly helpful.

Numerous experiments were performed on the concentrates, following more or less closely the method of procedure outlined in the articles mentioned, with very gratifying results. It was not only possible to effect a clean separation, but the two concentrates produced were as good as those resulting from Australian practice. It was found that the iron followed the lead, which was conducive to a high-grade zinc. A large portion of the insoluble, together with much of the lime contained in the gangue, followed the lead, and while it was easy to clean the lead product it was decided to abandon this procedure since as a rule the iron was in excess of the silica and would not be a detriment to its sale-value.

The stock of concentrate, referred to previously, which constituted the feed for the experimental work and also the feed to the commercial plant as finally adopted, not only contained the small amount of necessary flotation-oils but in addition there had been added pine-oil, in varying amounts, to the concentrate as a froth-breaker. Besides this large amount of pine-oil, much lime had also been added to the Oliver filter for the purpose of assisting the filtering qualities of the slimy material. While the lime did not interfere with the Bradford work, the excessive amount of pine-oil caused trouble from the beginning, because as soon as the dried concentrate was mixed with water a voluminous froth was produced. In an effort to counteract the effect of this excessive amount of pine-oil, the feed was subjected first to a preliminary treatment with caustic soda, by adding an amount equal to about three pounds per ton, for three-quarters of an hour, allowing to settle, and decanting the supernatant liquor. Sometimes washing out the remaining soda was resorted to, and at other times not. The pulp thus treated was then made slightly acid with sulphuric acid, saturated with sulphur di-oxide gas, and then treated in the testing machine with sufficient oil to float the lead and iron. Usually when following this procedure the original frothing was eliminated and an entire new froth produced which carried lead-iron and the very finest of the insoluble. A comparatively small amount of oil was required and the froth produced increased in lead content with the duration of the test. The final froth removed consisted of a clean lead product. The whole of the lead-iron and lead were mixed, however, forming one product, which was cleaned afterward by adding a quantity of fresh water and simply introducing it again into the test-machine.

The tailing from the lead treatment was now highly acidified, a small amount of pine-oil added, and the zinc removed. This zinc was cleaned in the same manner as the lead.

The following assays show the contents of the various products resulting from this treatment:

	Lead %	Zinc %	Silver oz	Copper %	Iron %	Insol. %
Feed	20.2	29.2	....	...	...	..
Lead-concentrate	41.4	3.5	22.75	3.95	14.1	8.4
Lead-cleaner tailing	24.4	6.4	16.00	...	...	..
Bradford tailing	8.0	4.7	3.40	...	...	..
Zinc-concentrate	2.9	54.9	6.20	1.44	5.3	1.7
Zinc-cleaner tailing	11.4	20.3	8.20	...	...	..

Tests giving these results could be repeated at will. Therefore it was decided to build a small plant of about 25 to 30 tons per 24 hours capacity to ascertain whether or not it was possible to reproduce the laboratory work in a commercial unit. The tests were all run in a Janney test-machine.

Mill-Work. Because of the ease with which the separation could be effected in the laboratory, the duplication on a large scale appeared to be a simple matter. The necessary tanks for preliminary treatment of the pulp were at hand, and it only remained to build a Bradford machine, arrange the whole into a continuous unit, and proceed. Machines of the Bradford type were constructed for the lead, using open-runner centrifugal pumps as agitators. After every sort of an arrangement for introducing SO_2 gas and air into the machines by way of the pumps was tried they were discarded as a dismal failure.

A sort of a Minerals Separation machine, having connections between the spitzkasten instead of from spitzkasten to the succeeding mixer, had been built to float the zinc from the lead tailing and this was finally used for the lead as well, with satisfaction. Before deciding finally upon this M. S. type of machine, several air and mechanical-air machines were tried without favorable results. It was supposed for a time that introducing air in place of a mixture of air and sulphur di-oxide gas into the pulp would be a detriment to the process, which accounts for the trials with the several types of machines.

The concentrates from the stock-pile were sluiced into a pump-sump and delivered to six tanks 9 ft. diam. by 6 ft. high. This pumping was watched closely in order to obtain a pulp carrying about 25% solid. Whenever the solid fell below 20%, the sediment in the tank was allowed to settle, the clear water drawn off, and the tank re-filled. In this manner the proper density was maintained. As soon as a tank was filled, caustic soda was added in an amount equal to three pounds per ton, the pulp agitated for one hour, then allowed to settle, and the liquor drawn off. The tank was now filled with fresh water and the pulp slightly acidified with sulphuric acid. Then sulphur di-oxide gas was introduced from a sulphur-burner. These steps were all performed with great care in order to duplicate exactly the laboratory practice, but it was found that while the lead and zinc from one tank would separate beautifully, that from another would do nothing. Then we tried washing of the pulp with [illegible] of caustic soda. This gave the same erratic results. Again the elimination of the caustic soda altogether and slightly acidifying with sulphuric acid was tried. This too gave both good and poor results.

The caustic-soda bath was simply to get rid of the original flotation-oil, but when it was left out the process became exactly a duplication of Australian practice.

In some instances sodium thio-sulphate was added previous to the addition of acid, the idea being to liberate sulphur di-oxide within the pulp by the action of sulphuric acid on the 'hypo'. There did not seem to be any merit in this procedure, although in Australia it is considered essential.

After experimenting for about five months along the lines stated above there seemed to be no hope of transforming the work of the laboratory into practice, and a decision to discontinue the work was practically reached. Up to this point the duplication of Australian work was always in mind and any deviation therefrom to any extent had not been considered. Just at this time a laboratory test had shown that a separation could be made without the use of 'hypo' or acid or a combination of the two, and accordingly the use of sulphur di-oxide alone was tried in the mill. The result was that the work could be duplicated with each succeeding tank of pulp and the prospect of a successful preferential plant suddenly began to re-appear. The plant began to produce a lead-concentrate day after day, and soon three shifts were put on and the plant kept moving. Operations were intermittent owing to the fact that the pulp was prepared in each tank separately. The time required to gassify varied greatly. Occasionally the time required was an hour and a half; at others three hours would be required. The reason for this was attributed to the varying amount of lime that had been added to the concentrate originally.

The tailing from the lead machines was stored in a Dorr thickener and after allowing it to accumulate for a week or so it was treated for zinc by adding acid and heat, and re-floating.

The stock of concentrate began to disappear and it became necessary to replenish the supply. To do this the old Midvale Minerals mill was put in shape to run on U. S. tailing.

Present Practice. There are two tailing-flumes that leave the U. S. mill, each carrying approximately 4500 gal. of pulp per minute, containing $1\frac{1}{2}$ to 2% solid. These flumes are run into a 90-ft. Dorr thickener built of concrete. The sides of the tank are four feet deep. The bottom is conical, and at the apex of the bottom the depth of the tank is ten feet. At the time of its erection this thickener was unique, because the truss is made entirely of concrete and was the longest concrete span in Utah. Besides the current tailing discharged from the U. S. mill, there is also a large tailing-pond. Because the tonnage from the U. S. mill is not sufficient for our operations, tailing from the pond is sluiced into the thickener to make up the necessary tonnage of about 500 tons. The pulp is thickened to 25% solid and pumped with a 4-in. Krogh dredge-pump a distance of 500 ft. to a 36-in. three-section trommel, dressed with 3-mm. punched screen, to remove trash. The undersize from the trommel goes to a 30-ft.

Dorr agitator, which serves as a supply-tank for the selective mill-feed. The discharge from this agitator goes to a bucket-elevator, which discharges directly into two Janney emulsifiers. Flotation-oil is added to the elevator. The emulsifiers discharge to a bank of Janney mechanical-flotation machines. These machines have been remodeled and fitted with air-pans. Air at four pounds pressure is supplied by a Sturtevant blower. There are nine of these machines in series, the tailing from which goes to three Janney mechanical-air machines. The tailing from these goes to waste and the concentrate from all goes to air-cleaners, in which it is cleaned twice. The tailing from the air-machines goes to a thickener, the thickened pulp being discharged to the elevator feeding the Janney emulsifiers. The concentrate from the air-cleaner machines goes to a 30-ft. Dorr thickener, which serves as a feed-supply tank for the lead plant.

Soon after starting operations in the selective mill, it became apparent that a continuous feed to the lead plant would give more satisfactory and uniform results than preparing the pulp intermittently. So four of the lead-pulp tanks were connected in series. The discharge from the 30-ft. Dorr thickener last mentioned is conveyed by an elevator to the first of the lead-tanks, through all of which it flows continuously. Sulphur di-oxide gas is introduced into the first two tanks, proper gassing being regulated by returning varying proportions of the feed going to the lead-machines back to the first tank. The pulp is maintained at 20% solid and flows from the fourth tank to a 3-in. Krogh sand-and-tailing pump, to be delivered to the feed-box of the lead-machines.

The lead-machines consist of four 6-ft. Fagergren flotation machines in series. These machines were invented some three years ago and have been perfected to a high degree of efficiency at this plant. The outstanding features are that they maintain their efficiency throughout the life of parts, while in any other type of machine the efficiency begins to decrease the moment that they are started; the pulp is always in motion and the froth is still except for its movement upward and over the lip; it is practically fool-proof, because there are no adjustments once the pulp-level has been established.

Oil is added to each of the machines; the amount, of course, being regulated as required. The lead-concentrate carries an excessive amount of fine silica, which makes the subsequent filtering very difficult. This concentrate is sent to a 30-ft. Dorr thickener, and the thickened concentrate to a 6 by 6-ft. Oliver filter. Live steam is introduced directly into the pulp within the filter, thereby hastening the filtering operation.

The tailing from the lead-machines goes to a 30-ft. Dorr thickener from which it is drawn and pumped to two 8 by 10-ft. tanks. The time element is an important factor in the treatment of the zinc. The SO_2 gas must be eliminated; this is accomplished by the addition of sulphuric acid and heating to 130°F. The time required for the action of the acid and heat varies so that up to this writing it has not been possible to run the zinc plant continuously. By this is meant having a continuous flow from the Dorr to the machines; the pulp being prepared in the tanks separately and treated as soon as they are ready, which is determined by trial. This makes the operation of the zinc section sluggish although satisfactory.

From these 8 by 10-ft. pulp-tanks the feed flows to two 6-ft. Fagergren flotation-machines, where a very small amount of oil is added and the zinc floated off. These machines were a great surprise because practically all the zinc is removed on the first machine; what little does come off from the second machine is returned to the air-machines of the selective plant. The first machine makes a concentrate running as low as 2.5% insoluble, the average being 3.8%. The tailing runs as low as 1.5% in zinc and 1% in sulphide lead. This zinc operation amounts to the same thing as a cleaning operation in other mills, and as far as we know from experience, or are able to learn, there are no other cleaners in the country doing like work on a whole series, let alone on one machine. The tailing is kept so poor that it is thrown away. The concentrate is dry enough to be sent directly to an 8 by 8-ft. Oliver filter.

Since the operations have included the treatment of U S. tailing, the iron has shown a decided inclination to remain with the zinc, so that it has become impossible to make better than a 42%-zinc concentrate. It had been noticed, however, that on warming the solution in preparation for the zinc-machines an iron froth formed on the tank. Consequently, test-runs were made taking this heated pulp and re-running it before adding acid and sending it to the zinc-machines. These tests have shown that it is practicable to remove an iron-lead product which leaves a tailing from which it is possible to make a 50%-zinc concentrate. Accordingly, the mill is being arranged to do this.

The following assays are taken from daily operations:

Selective Plant

		Mill-feed		Janney-feed		Mill-tailing		Air-concentrate	
		Zinc	Lead	Zinc	Lead	Zinc	Lead	Zinc	Lead
1920		%	%	%	%	%	%	%	%
Aug.	7	4.9	3.4	5.4	3.6	2.4	0.7	31.2	19.9
"	8	5.3	3.2	6.0	3.7	2.5	1.0	34.7	21.4
"	9	4.4	2.5	4.9	2.7	2.4	0.7	29.8	17.5
"	10	5.2	1.5	5.5	1.9	2.5	0.5	30.0	17.7
"	11	4.7	1.8	5.7	2.1	2.5	0.7	32.5	18.9
"	12	3.2	1.7	5.5	2.6	2.1	0.3	26.4	17.1
"	13	3.9	3.0	4.9	3.8	2.2	0.4	26.1	17.9
"	14	3.4	1.9	4.2	2.8	1.6	0.4	29.7	16.1
"	15	4.2	3.0	4.7	3.6	2.1	0.4	33.6	21.0
"	20	4.5	1.0	6.1	3.3	1.8	0.3	32.4	17.2
"	21	4.5	1.0	6.2	3.0	2.1	0.4	32.1	18.6
"	22	4.8	2.9	7.8	3.3	2.8	0.3	35.0	20.0
"	23	5.1	2.5	6.0	3.3	1.9	0.2	27.1	14.7
"	24	4.3	0.8	5.1	1.9	1.6	0.3	28.7	12.5
"	25	4.8	3.0	6.6	4.1	2.3	0.3	31.8	14.3
Sept.	7	5.2	3.0	5.2	3.6	1.8	0.4	26.4	13.9
"	8	4.2	2.9	5.7	3.4	1.1	0.3	31.8	17.1

Lead Section

		Lead-feed		Lead-concentrate		Lead-tailing	
		Zinc	Lead	Zinc	Lead	Zinc	Lead
1920		%	%	%	%	%	%
Aug.	7	27.9	14.0	16.2	44.4	31.3	7.5
"	8	27.1	13.9	17.3	39.0	28.6	8.2
"	9	27.7	15.1	16.3	39.5	31.3	9.0
"	10	24.6	13.9	15.9	43.9	27.6	7.2
"	11	24.0	18.2	15.9	36.6	27.7	8.7
"	12	22.7	14.7	14.5	36.9	25.7	8.4
"	13	21.8	13.6	9.9	44.9	24.2	8.6
"	14	22.3	12.4	11.9	39.1	25.3	6.7
"	15	26.0	16.4	14.1	41.9	29.2	6.5
"	20	30.4	13.1	15.7	41.7	31.8	5.4
"	21	26.8	14.5	17.7	40.0	29.7	6.6
"	22	30.7	15.3	14.5	44.2	38.5	6.0
"	23			15.8	41.0	36.5	4.6
"	24	28.7	12.7	13.9	39.1	30.8	4.9
"	25	25.8	12.0	15.3	40.9	30.1	6.0
Sept.	7	29.2	13.4	10.8	49.2	33.2	3.8
"	8	27.8	14.3	10.2	47.9	32.2	4.2

Zinc Section

	Zinc feed		Zinc concentrate			Zinc tailing	
	Zinc	Lead	Zinc	Lead	Insol.	Zinc	Lead
1920	%	%	%	%	%	%	%
Aug. 7.....	33.4	5.6	42.5	6.4	5.2	2.7	6.9
" 8.....	32.5	7.1	40.9	4.7	4.1	2.1	6.2
" 9.....	32.5	6.2	41.2	8.8	4.0	3.0	6.2
" 10.....	32.0	7.3	41.1	7.3	4.1	2.7	5.5
" 11.....	32.3	9.0	41.5	8.7	4.0	3.6	4.9
" 12.....	29.2	8.5	41.5	7.4	5.5	2.8	5.8
" 13.....	25.8	9.0	37.6	9.3	6.2	2.3	5.6
" 14.....	26.2	8.0	37.6	9.1	5.4	2.1	4.9
" 15.....	23.8	7.7	36.9	8.8	5.0	2.5	5.6
" 20.....	27.3	7.9	40.0	8.4	4.5	2.3	4.7
" 21.....	31.1	7.5	39.7	6.8	5.1	4.2	5.3
" 22.....	32.1	9.4	40.2	6.7	4.8	2.7	5.0
" 23.....	34.6	7.0	41.7	7.2	5.1	4.4	4.9
" 24.....	35.0	7.2	40.0	8.4	4.6	2.9	5.3
" 25.....	32.0	7.4	40.8	7.9	4.0	2.2	5.2

Eighty per cent of the lead in the zinc-tailing consists of oxidized lead, the other 20% being lead sulphide.

Blast-Furnaces at Copper Cliff

The following description of the blast-furnaces used at the Copper Cliff plant of the International Nickel Co. appeared in the August Bulletin of the C. I. of M. & M. There are eight furnaces in this department. Five of them are 17 ft. long, one is 21½ ft. and two are 25½ ft., giving a total furnace length of 157¼ ft. All have the same width at the tuyeres, namely, 50 in., and are similar in construction throughout except for such differences as are due to the different lengths. The cast-iron hearth-plates are supported by 12-in. I-beams laid transversely to the furnace length. No cooling is provided for these plates beyond that due to the air naturally circulating under them. The crucible of the furnace is built of chrome-bricks, which, at the sides, come up to within 6 in. of the tuyeres and are stepped down to the centre in the form of a 'V', the minimum thickness of brick being 18 in. The sides of the furnace are formed of sections 4 ft. 3 in. wide, containing six jackets for the full height of the furnace. First there is a pair of cast-iron tuyere-jackets (in which are embedded 1¼-in. water-pipes), each 2 ft. 1¼ in. wide and 4 ft. 7 in. high, resting on the hearth plates. Each of the pair has, near the top, two tuyere-openings 6 in. diam. Above the tuyere-jackets is another pair of cast-iron jackets of the same width and of similar construction, but only 3 ft. 11 in. high. Above these is a steel water-jacket 3 ft. 6 in. high and 4 ft. 3 in. wide, and finally another steel jacket 6 ft. high and 4 ft. 3 in. wide.

The use of the small steel jacket was made necessary when the height of the furnace was increased several years ago. The cast-iron jackets are given a slope outward to form the bosh of the furnace, the maximum inside width being 5 ft. 10 in., an increase from 2 ft. 10 in. at the hearth-plates. The steel jackets are vertical. The 17-ft. furnace requires four of these sections to the side, the 21¼-ft. furnace, five, and the 25½-ft. furnace, six. At the dead end of the furnace the lowest jacket is of cast-iron with water-pipes imbedded in the same way as with the cast-iron side-jackets. It is 3 ft. 9 in. high and above it are three steel water-jackets, 4 ft. 9 in., 3 ft. 6 in., and 6 ft. high, respectively. At the front end the lowest jacket is of copper 32 in. wide and 5 ft. long, with the lower edge 1 ft. 11 in. above the hearth-plates. This forms the trap of the furnace. The top of the copper jacket is the same height above the hearth-plate as the top of the cast-iron jacket at the dead end, and hence the remainder of the jackets at the front are the same as those at the dead end. Each furnace is provided with a small side tap-jacket fitted into a notched tuyere-jacket and placed near the middle of the furnace.

The spout is of chrome-brick built against the copper jacket. It is carried on a 4-in. cast-iron plate about 4 ft. wide and 5 ft. long, which rests on the bottom plate of the furnace and the side of the settler. Cast-iron water-cooled side-plates retain and protect the brick. A water-cooled cast-iron lip is placed where the mixed matte and slag flow from the spout. Further protection to the brick is given by another cast-iron cooler placed under the lip. The effective depth of the trap formed by the spout and the copper jacket is about 9 in. This type of spout was developed at the plant to overcome trouble with corrosive low-grade copper-nickel mattes, and has proved very satisfactory. A cut-out of the spout is practically unknown.

At the Creighton mine of the International Nickel Co. the same rounds are drilled in all drifts and cross-cut headings, varying only in the number of 'easers'. The four-hole centre-pyramid cut is used, and from 17 to 22 holes, usually 19, are drilled in a round. Great care is taken to bring the cut-holes near to the point of intersection, and to properly place the 'easers'. Cuts are blasted and enlarged separately, before the 'square-up' is blasted. Rounds varying in length from 6½ to 7½ ft. are broken. Polar Forcite of 40% strength is used for all classes of work. Experiments with different types and lengths of rounds have been conducted. Rounds averaging 10 ft. in length were broken during a period of 30 days with the same speed per machine-shift and less powder per foot driven, but the large amount of broken rock to be handled interfered with the cycle of operations. Two Sullivan (DR6) drills are used in each heading. The air-pressure is 100 lb. Hollow hexagonal steel 1⅛ in. diameter is used. Cross-bits, with 14° and 5° taper and reaming edge, are gauged 2½ in. on 2-ft. 'starters' and decrease ⅛ in. per foot to a length of 8 ft.; thereafter the decrease is $\frac{1}{16}$ in. per foot to 14 ft., and there is a difference of ½ in. between the gauge of 14-ft. steel and that of 20-ft. As it is necessary to drill 16-ft. holes in the stopes, and as the bits of 16-ft. steel are 1$\frac{5}{16}$ in. diam., this bit-gauge is used throughout the mine in order to avoid confusion and to standardize shop-work. Experiments are being made with small-gauge bits on development work, commencing with 2-in. 'starter' bits and finishing with 1⅜-in. bit at 10 ft. A 7½-ft. round in granite is drilled in one and one half shifts, or three drill-shifts. During the period from July to December 1919 the advance per drill-shift in drifts and cross-cuts was 2.3 ft., consumption of powder averaging 19.4 lb. per foot driven. Drills are tested on a granite block in the repair shop and must cut three inches per minute using a 2½-in. bit.

Some Cornish Mining Terms

By T. A. RICKARD

The origin of many terms now an integral part of the miner's vocabulary is to be found in the glossary annexed to a fine old book called 'Mineralogia Cornubiensis', by William Pryce, "of Redruth in Cornwall". This volume, published in 1778, is a Cornish 'De Re Metallica' and contains much of the same kind of shrewd commonsense as distinguishes the more famous book by Georgius Agricola, now known to the profession by means of Herbert Hoover's translation. Indeed, Dr. Pryce quotes his predecessor of 1556 more than once.

The learned Cornishman calls his glossary 'An Explanation of the Cornu-Technical Terms and Idioms of Tinners'. It is interesting because it gives us the origin of many familiar words. For instance, 'winze'. This is a corrupt form of 'winds', namely, a place where they wind. The word 'wind' is Old English and means to go in a curved or circular course, as around a windlass, in which *windill* = winder and *ass* = beam. In the North of England, says Pryce, a 'winds' is called 'the turn', referring to the axletree or cylinder on which as it turns the rope is wound. 'Little-winds' is defined as "an underground shaft, sunk from a horizontal drift, by which the top of the winds communicates with the side or bottom of the grass working-shaft". 'Grass', we are told, "signifies on the surface of the earth". For example, "Is Tom Treviscas underground? No; he is at grass". "He is on top", as we would say.

'Costean' is Cornish; it comes from *cothas,* to find, and *stean,* tin. Pryce also gives 'dropt-tin' as the equivalent, suggesting that 'to find' is not the literal translation of *cothas.* To costean is to dig a pit to bedrock in search of ore.

'Gad' is Cornish for wedge. 'Cob' is "to break or bruise". 'Spal' is "to break large solid blocks of ore with sledges to a smaller size, in order to cull out the barren stony parts". A 'gossan' is "a kind of imperfect iron ore, commonly of a tender rotten substance, and red or rusty iron color. It is an upper covering to the ore". The German *eiserner hut,* or iron cap, is expressive. 'Jigging' is "a method of dressing the smaller copper and lead ores by a peculiar motion of a wire sieve in a kieve or vat of water, where the smallest particles pass through the jigging-sieve, and those which are larger and solid lie at the bottom of the jigging-sieve or jigger; so that the uppermost light stony waste may be easily separated and skimmed off by a piece of semicircular board, called a limp". 'Plat', as we use it, is a corrupt form of 'plot'. Pryce says: " 'to cut a Plot' is to make room, or square out a piece of ground by the side of the Lode or Shaft, for holding broken work or deads before they are brought to grass or for other convenient purposes". Dr. Pryce's definition of 'horse' is not a happy one; he says: "A portion of dead ground in a Lode, which widens like a horse's back from the spine". Surely it comes from the fact that when the lode is split by a wedge of rock, the lode rides it with a leg on each side. I am reminded of the story told of Clarence King, who was sent to examine a mine in Utah in which a 'horse' was reported to have spoiled the prospects of continued productivity. He found more than one horse, so he telegraphed to the directors: "Your mine is a regular livery-stable". 'Resue' has almost gone out of use, but the Cornish in Gilpin county, Colorado, and those at Grass Valley, California, will be found to retain it. It means the stripping of veins in a stope, by removing the adjacent rock first and then taking down the ore separately, and cleanly. Pryce gives it as 'dizzue', and says: "To dizzue the Lode is this: If it is very small and rich, they commonly only break down the country or stratum on one side of it, by which the Lode is laid bare, and may be afterwards taken down clean and free from waste . . . The refuse or deads of a Dyzhued Lode is called in some places the Dyzha". Note how he says "dyzhued", not 'dizzued', because 'dizzue' comes, he says, "from the Cornish 'dyzhue', to discover unto". In Cornwall they still use the form 'desue'. It is possible that 'resue', as suggested by Mr. R. Arthur Thomas, comes to us not from the Cornish but from the Welsh, for the Welsh word 'resgyw' means to liberate, to open, to make loose, or set at large.

Another interesting old word is 'vug', sometimes written 'vugh' in order to indicate the hard sound of the 'g'. Pryce says: " 'Vooga'. Smoak. We also call a hollow cavern, either in the earth, or the Mines, or by the fretting of the sea, a Vooga; in the Mines, a Vooga-hole." So today the American miner speaks of a vug or vughole, meaning any small cavity in the lode. It is commonly a place for finding crystalline growths and beautiful specimens of minerals, which, owing to the space becoming filled with clay or slime, have had an opportunity to develop without interference. 'Vug' used to mean smoke or a place for smoke. The Welsh have 'fwg', smoke. The 'w' in Welsh sounds like 'oo' in food, says Mr. Thomas. Again we have the likeness between Cornish and Welsh, both of which languages are descended from the Armoric branch of Celtic. Welsh is a living language today, whereas the last person to speak Cornish died about forty years ago.

Many of the Cornish terms came from the miners of Saxony, who preceded the Cornish themselves as the professors of mining. Freiberg was a school of mining before Redruth, and Dr. Pryce acknowledges the fact, etymologically, in his glossary. To the Saxons we owe 'stope', a step; 'stull', from *stolle,* a prop; 'shaft', a groove or pit. 'Sump' or 'sumph', says Dr. Pryce, is "a pit sunk in the very bottom of the mine; it serves as a basin or reservoir, to collect the water of a Mine together, that it may be drawn out by an engine or machine".

'Shode' is an old Cornish term of Teutonic origin. Probably from *shutten,* to pour forth. "Shoding", says Pryce, "is the method of finding veins of Tin by digging small pits in order to trade out the Lodes of Tin, by the scattering loose stones and fragments that were dispersed from them by the retiring waters of the deluge: these loose stones thus dispersed are Shode stones". This the American miner calls 'float', which also suggests a "deluge", in other words, the sorting action of rainfall

and rivulet. Dr. Pryce spells 'deluge' with a small 'd', but he appears to be referring to the Noachian fable. Another curious Cornish word is 'learies', which means emptiness and refers to old stopes. Undoubtedly it is a form of 'leeries' and comes from the German *leer*, meaning 'empty'. From the French, probably through Brittany, from which so many of the Cornish migrated, we obtained 'van' and 'vanning' shovel. Dr. Pryce says: "Van (From the French, Avant, foremost). To make a Van is to take a handful of the Ore or Tin-stuff, and bruise, wash, and cleanse it on a shovel, to shake and throw forth upon the point of it almost all the Ore that is freed from waste." . . "Quarrie. When a Lode or Stratum breaks in large hard rocks, being jointed, as it were, it is called a Quârey Lode or Stratum, for its joints or Quâres." The word comes from the Latin *quadrare*, to square. Note how under the definition of 'Plot' or 'Plat', Pryce says "to square out a piece of ground", meaning to excavate a space square in plan. The French word for 'quarry' is *carrière*, from *carré*, square or quadratic. 'Huel' is another word that links Brittany with Cornwall. It survives in both, although in the English county it is often spelled 'wheal'. Pryce says: "Huel. A Work, a Mine; as Huel Stean, a Tin Mine: Huel Kalish, the hard work." Notwithstanding this, the Cornish will say Huel Virgin Mine, which means 'mine Virgin mine', showing how the original significance of 'huel' is ignored. There was a mine called the Great Wheal Work, a name in which 'wheal' and 'work' are synonyms. Pryce gives, "Core (i. e., Corps; body, company, society). Corps is used among the military, and pronounced Core. With the Tinners it has also a respect of time, such as their proper change or turn of working. Thus it is said, the first Core by night is eight o'clock, for instance; the second Core is four after midnight, and the day Core commences perhaps at noon-day, according as the labourers will settle among themselves. But in difficult and hard working places, where water is too troublesome, or air is very deficient, they divide their Cores into four; that is, every six hours." Thus 'core' is equivalent to 'shift'.

Let us conclude with some familiar Cornish words; for example, 'elvan'. Pryce says that it means "a very hard close-grained stone, thought to be bastard limestone". It comes from 'elven', in Cornish an element, a spark of fire". Evidently a stone against which steel strikes fire. Since Pryce's time it has become synonymous with igneous rock, especially granite, in dike form.

'Flookan', says Pryce, is "an earth or clay of a slimy glutinous condition". Again, "a small slide is also a fissure filled with clay or Flookan". The form 'flucan' is usual nowadays.

Last, there is our old friend 'quartz'. Pryce spells it 'quarts'. He says: "A hard, opaque, and sometimes semi-transparent crystalline stony mass, vulgarly called Spar, which it is not, being a chrystalline basis". The 'h' in 'chrystalline' shows that typographic errors were made [illegible] years ago as today. Pryce says nothing about its derivation, which is from the German *quarz*, without [illegible]. The use of 'quarts' explains why some old Cornish miners speak of "them quarts". Many years ago, at Melbourne, E. J. Dunn, the distinguished geologist, told me how when he was a small boy among a shipload of emigrants on their way to the gold diggings of Ballarat and Bendigo, he heard the word 'quarts' used by the unsophisticated as if it meant double pints. They expected to find gold in quarts!

THE Mule Creek oil-field is in eastern Wyoming, only 4 miles from the South Dakota line, about 35 miles northeast of the well-known Lance Creek field and 100 miles east of the Salt Creek field. It is the most productive field in Wyoming. The presence of petroleum in commercial quantities in this region had long been suspected, and in recent years considerable drilling had been done on a prominent anticline there, but most of it was done to validate claims, and, though many 'shows' of oil were reported, the wells were not sunk deep enough to test the anticline thoroughly. In 1919 the geologists of the Ohio Oil Co. discovered a second anticline south-east of the prominent anticline to which drilling had been confined, and the company drilled on this south-eastern anticline a test well which proved to be the discovery well of the field. The production of this first well was small compared with that of the wells in the near-by Lance Creek field, but its success stimulated extensive drilling, and by the fall of 1919 about 10 wells on the south-eastern anticline were each producing daily 125 to 150 barrels of oil of high grade. Drilling was not confined to the south-eastern anticline, however, and late in 1919 no large quantity of oil had been found except in wells drilled near its axis. The Mule Creek oil-field is described in a report by E. T. Hancock just published by the U. S. Geological Survey as Bulletin 716-C, which may be obtained free of charge.

COPPER-NICKEL ore is roasted in beds at Copper Cliff, Ontario. The only preparation required before beginning to build a bed is to lay the wood necessary to start the roasting. The wood for each bed covers a rectangular area about 100 ft. long and 60 ft. wide. The width is determined by the distance between the railroad tracks, but the length is largely a matter of convenience in building and lighting. The fuel used is the usual 4-ft. cordwood, and it should be of good quality. The finished bed contains about 5000 tons of ore. The beds are lighted as soon as possible after the building is completed. As the wood burns away, the ore settles down and cracks develop in the surface of the bed. This is the critical time of the process, and bed-trimmers are constantly on the alert, during the first week or two of the burning, to close these cracks as quickly as possible. After the subsidence is completed no more openings are likely to form, and the bed requires practically no further attention. It will probably burn for six or seven months, by which time the sulphur will be reduced to about 10%. The roasted ore is re-claimed from the beds by two Atlantic steam-shovels having a dipper capacity of 2½ cu. yd. They load the roasted ore into the same 50-ton cars that bring the green ore from the mine.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

RESULTS AT THE SUPERIOR & BOSTON.

GLOBE.—A strike was called at the Arizona Commercial Mining Co.'s mine, the reason given being the discharge of one of the shift-bosses, who was very popular with the men. At the Miami Copper Co.'s plant the portal of the lumber-yard tunnel is being concreted. The completion of this tunnel will greatly facilitate the handling of all timber as it will then be possible to take the timber from the yards direct, on the same level, to the No. 5 shaft, through which it will be lowered to the various working levels. The timber is at present being hoisted up a long incline to the collar of No. 4 shaft and then lowered to its destination. Rapid progress is being made in the underground connections between No. 5 and No. 4 shafts, connections having been completed on the 570-ft. and 720-ft. levels. The 850-ft. drift from No. 5 has been driven to a point below the bottom of No. 4 shaft and raising from this point to make connection with shaft No. 4 will be started at once. It is reported that the Atlantis Mining Co. at Payson is making good progress in developing its silver and gold property. A force of men is now engaged in sinking a shaft on the Atlantis claims. The diamond-drilling at the Ray Boston Copper Co.'s property near Kelvin is said to have reached a depth of 1440 ft. and is expected to cut the vein within the next 40 or 50 ft. Future development will, of course, depend largely on the core-showings at this depth. In his recent report for the third quarter of the fiscal year, 1919-'20, T. R. Drummond, president of the Superior & Boston Copper Co., states that during this period 2156 ft. of development work was done, in addition to 2007 ft. of diamond-drilling, as compared with 2211 ft. the previous quarter, and 1301 ft. for the same quarter last year. From this development work 9065 tons of waste has been hoisted, in addition to 2254 dry tons of ore from development work and stoping. This ore has averaged 5.56% copper and 13.35 oz. silver. The net smelter-returns were $44,455.65, an average of $19.73 per ton. This includes several cars of low-grade silicious ore, which have been shipped to local smelters and on which a favorable rate was made as this class of ore is in demand. The replacement of decayed timbers in the McGraw shaft has been completed. The collar set has been concreted and the shaft is now in good condition. Fuel-oil consumption in the power-plant has continued to decrease, June consumption being the lowest of any month in recent years. Against this the price of fuel-oil is 17% greater than last year, so that the saving by the decreased consumption amounts to only $250 per month compared with the cost in June of last year. The amount of water to be pumped continues to decrease. In June less than seven million gallons was pumped as compared with over eleven million gallons last June. On July 1 the company had a balance of cash and cash assets of $145,727, not including ore in transit.

TUCSON.—The annual convention of the Liga Protectora Latina, an association of the Spanish-speaking population of the south-west, formed especially to combat radical propaganda, and composed almost entirely of American citizens, was held recently at Tucson. The order has a membership of approximately 2500 members.

Mining conditions in general were discussed at length at the quarterly meeting of the Arizona chapter of the American Mining Congress, held at Tucson on September 13.

WARREN DISTRICT.—Recent strikes of copper ore in the White Tail Deer section, the southern end of the Warren district, are of great importance and indicate the future extension of mining operations into this part of the district. A big body of sulphide ore of good commercial grade was recently opened up by the Boras Leasing Co. on the 600-ft. level of the property belonging to the Copper Queen Mining Co. Oxide and carbonate ores had been mined on a small scale in the White Tail Deer section for the last few years, but this is the first discovery of sulphide ore that has been made there. The orebody has not been fully developed. The Calumet & Arizona Mining Co. has completed a ventilation-shaft, sunk for the purpose of providing an outlet for smoke and fume from a fire-area in the Briggs mine between the 1300 and 1400-ft. levels. The total depth of the shaft is 786 ft. and it is connected by drifts with the fire-area, which is bulkheaded off from the rest of the mine, the only outlet being through this shaft. It is thought that there is no actual fire in the mine at the present time, but the admission of air into the sulphide stopes probably would fan the flames into action again.

GLOBE-MIAMI DISTRICT.—Taking the output for the eight months of the current year as a basis, the Miami Copper Co. will produce the largest amount of copper ever recorded by the company, with the possible exception of 1918, when, under the stimulus of a heavy war demand, the output for the year totaled 58,500,000 lb. More than 37,000,000 lb. has been reported up to the end of August, indicating approximately 56,000,000 lb. for the full year. This showing comes in the face of a stagnant copper market and is possible on account of low producing costs at Miami.

BISBEE.—The North Tigre Leasing Co.'s mill, recently

started up, is reported as running satisfactorily. Three carloads of concentrate have been shipped to the smelter at El Paso. The output has been curtailed owing to the shortage of water, but it is expected that this difficulty will be overcome within thirty days. It is reported that a large body of 12% azurite copper ore has been opened in the Night Hawk mine. The ore was cut in the 650-ft. level, 250 ft. east of the shaft. One hundred feet of the ore has been exposed by drifting and it is expected that the orebody will extend to the Boras side-line and connect with the sulphide ore recently opened on that property. A raise which is being made from the Boras drift has advanced 15 ft. and is still in ore. This work proves the ore over the Boras drift, although when the drift was first run the ore was not found. James McKenna is superintendent. The recent strike of sulphide ore in the Boras lease has stimulated interest in the Don Luis region and the Don Luis Development Co. has been formed to take over the Finerty property, the litigation of which has been adjusted.

Camp Verde.—W. P. Blake has briefly described the deposits of glauberite, and associated minerals, a mile and a half south-west of this place, in a report to the Governor of Arizona. The deposits are 60 ft. thick in places and cover a considerable area. The Western Chemical Co., of Tonopah, W. B. Roberts, president, has recently leased two sections of this area, one from the State of Arizona and the other from private interests. It is the intention of the Western Chemical Co. to mine and ship for the present 100 tons of the natural salts to the refinery at Los Angeles, California. It is said that the resulting sodium sulphate is to be shipped to paper-pulp manufacturers in Finland.

Jerome.—Rock to the extent of 50,000 cu. yd. was recently blasted by ten tons of dynamite in the present steam-shovel operations of the United Verde. The blasting was carried out by means of four 110-ft. churn-drill holes. The holes were sprung by 600 lb. of powder each.

Oatman.—It is announced by the directors of the Tom Reed Mining Co. that the dividend rate is to be reduced to one cent per share per month, payable quarterly. This reduction is deemed necessary to provide funds for the large amount of development and prospecting that is now being done and at the same time build up a substantial reserve. The gross production of the United Eastern Mining Co. for the first seven months of 1920 was $1,213,657 and dividends paid out by the company in the same period were $776,910. The gross production of the Tom Reed for the same period was $452,628 and during that time it paid about $111,000 in dividends. It is reported that the United Eastern Mining Co. has installed a diamond-drill to carry out extensive exploration at depth.

Tombstone.—The Solstice Mining & Milling Co., owned by Boyd, Hughart, and Bladworth, has made the final payment for the purchase of the property. Engineers have reported that silver ore to the value of $120,000 is at present available in the mine. It is the plan of the company to install a 50-ton mill, hoist, air-compressor, and cyanide tanks.

COLORADO

NEW FIND IN THE VARNEY TUNNEL.

Aspen.—Large bodies of silver-lead-zinc ore have recently been encountered in the Varney tunnel in the Woody Creek-Porphyry Mountain district north of this city. The ore is claimed to be 30 ft. wide, part running 50% zinc and the remainder 20 oz. silver, 40% lead, and 30% zinc. The principal owners are D. M. Hyman and New York associates. The same interests are planning another tunnel into the mountain facing Porphyry where surface showings are reported better than at the Varney. The Aspen Silver Lead Mines Co. has cut the main ore contact on Porphyry mountain in its tunnel now 800 ft. long. The property lies just north of the Varney, and it is expected to cut the silver-lead ore-shoot in the next 100 ft. The Anaconda group north of the Aspen Silver Lead group has also cut the contact and has an excellent ore showing. This group is owned by Aspen miners who have spent considerable money and many years in its development. Rich ore has been uncovered in the Mayflower claim by the Park Tunnel company, operated by Leadville and local men.

The Smuggler management is adding more powerful pumps to unwater the mine and extract the lead-zinc ore standing in the old fire-stopes. The Hope company owning the Little Annie group 9 miles south of Aspen is installing electric power. The Hope tunnel has reached the Weber limestone-porphyry contact and it is expected the main ore-shoot will be cut soon.

Central City.—The Evergreen shaft has been sunk to the 850-ft. level, a station cut, and drifting started. It is reported that a Denver syndicate, operating the Annie B., is mining high-grade gold-silver-copper ore. The Barrick tunnel of the Saco de Oro company has been driven 850 ft. and the heading is reported to be highly mineralized with tale streaks containing fair amounts of gold. The objective point under the Rochester shaft is still 170 ft. distant, but it is expected that the vein which produced rich silver-gold ore in the shaft at 250 ft. will be cut on its dip within the next 100 ft. The tunnel will be 400 ft. beneath the shaft.

MICHIGAN

SHIPMENTS INCREASING

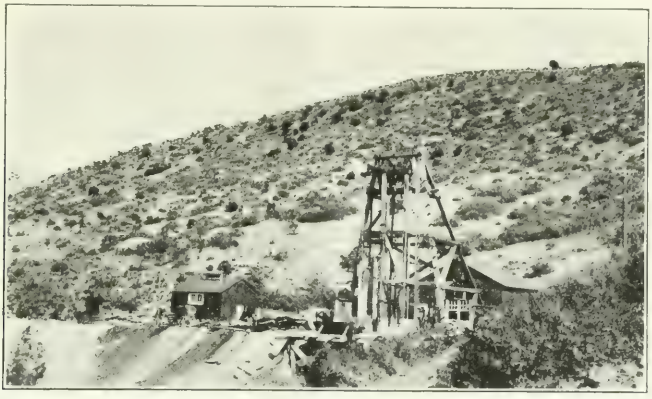
Calumet.—Small lots of copper are being shipped from the smelters to fill domestic orders. August refined-copper shipments from all the mines totaled 16,860,000 lb., an increase of over 6,000,000 lb. compared with July. August shipments greatly exceed those for any month of this year. The figures include only lake shipments, a small amount having been shipped by rail. Considering the comparatively dull market, the August record is refreshing, for it is 5,000,000 lb. in excess of the combined production of all mines.

The tonnage derived from the removal of pillars and the cleaning up of arches and backs of old stopes at the C. & H. will be less than in 1919 when 63 drills were employed exclusively in this work. In 1918, a battery of 80

drills was in commission in the final clean-up and a half million tons of 'rock' was recovered, compared with less than 350,000 tons last year. The old workings yield an immense amount of 'rock', particularly as the operations approach the surface, for there the strips of conglomerate run better than 80 lb. per ton. The removal of shaft-pillars in the Hecla department alone will be an undertaking that will take years to complete, because solid columns, nearly 100 ft. thick, extend from the surface to the bottom. All these pillars will be removed eventually and the shafts sealed, but not until operations extend below the 80th level, after which hoisting will be done through the haulage-way now nearing completion.

Arcadian Consolidated should reach the 600-ft. level in the New Baltic shaft within a few days. After cutting the 'plat' a cross-cut will be made into the vein and drifting started north and south. As only 10 or 15 ft. of cross-cutting is necessary before the lode is tapped, it should be a matter of not more than fifteen days before drifting is under way. Considerable interest is centred in Arcadian developments, for the disclosures of each succeeding level are important, not alone to the Arcadian but to properties on the north. The fourth level revealed a splendid showing and on the fifth level even higher-grade ore was reported. Accordingly there is a prospect that heavier mineralization will be noted on the sixth and downward. If this proves to be the case, the old fallacy about the ore becoming leaner with depth will be exploded. The only mine that opens leaner ground as it becomes deeper is the Calumet Conglomerate, for even Quincy, which has paid dividends since 1862, still yields nearly 22 lb. per ton. The ore developed by practically all of the Kearsarge-lode shafts is as high-grade as when the vein was first tapped and the Pewabic vein on Franklin property shows far better ore on the 39th level than 1000 ft. nearer surface. The Copper Range mines likewise are producing better ground than ever. While metallurgical developments account for some of the greater recovery, increase in the metal content of the ore is the rule as each shaft is deepened.

Cross-cutting on the Ahmeek fissure at the 16th level of No. 2 shaft has reached a point 300 ft. from the Kearsarge Conglomerate vein. On the 11th and 18th levels the tunnel is being driven toward the same formation. The fissure on the 16th level has reached a width of three or four feet and, as has been the case since it was first opened west of the shaft, it is rich in 'mass' copper. Drifting in the 'mass' fissure has been under way eastward from the 15th to the 22nd levels, except the 18th, while openings from the 22nd to the 26th, including the stopes, have developed ground that is entirely satisfactory. No. 2 shaft continues to show the richest ground and occasionally boosts the yield to more than 26 lb. per ton. By the end of the year it is expected that No. 4 shaft will have attained a depth of 175 ft. below the 21st level, nearly 3000 ft. On the hanging-wall side of this shaft, two feet of ore has been opened. There is no material change in No. 3 shaft so far as the grade of 'rock' is concerned. The most gratifying feature of Ahmeek's operations is the fact that the ore in No. 4 shaft, the most northerly, continues to improve in value with depth, while to the south Ahmeek has territory that has great possibilities. The fissure, however, is attracting the greatest attention at present, for it will provide an opportunity to do extensive exploratory work on the Kearsarge conglomerate at a place distant from the original openings.



No. 2 SHAFT OF THE ARIZONA COMMERCIAL, COPPER HILL, ARIZONA

White Pine, with a force of about 70 men, is producing a negligible quantity of refined copper, compared with its peak-production, although operations are going forward in preparation for the future. There is little probability that the force will be further reduced. With the present number of men it will be possible to develop ground that will yield a profit when market conditions become normal. With this mine situated so far from more thickly populated centres, the retention of the nucleus of a working organization is desirable and necessary to ensure an efficient crew later.

Power-lines are being erected between the Calumet & Hecla mills and Ahmeek, connecting with intervening

subsidiary mines which will be supplied with electricity and power by the parent company. Although it will be a long time before the new turbines at the mill are in commission the present supply may be sufficient to operate the new electric pumps at Kearsarge. For some time No. 1 Kearsarge shaft has been hoisting nothing but water, and bailers are in constant operation to handle water that seeps through from the surface as well as the flow from the abandoned South Kearsarge shafts.

Practically all the equipment of the old Tamarack mill has been moved to Calumet, where parts of it will be prepared for future use and the remainder scrapped. Excavating for the flotation and leaching units of the reclamation plant has begun. A large part of the steel to be used in the buildings, or at least the super-structure, will come from the old coal-storage structures at Hubbell, which were dismantled a year or two ago. The hoist at North Tamarack No. 3 shaft has been moved to Isle Royale, where it will go into commission at No. 5 shaft.

Seneca's fifth level 'plat' will be cut within ten days and before October 1 drifting will begin. In the meantime there will be no let-up in the work in the third and fourth levels, north, and by the time the fifth is well under way the shaft will be sunk to the sixth level. At Gratiot, the 13th-level south drift is progressing, with operations under way by two shifts. There is no change in the condition or quality of the ground.

Mayflower-Old Colony is continuing the raise in the west cross-cut, instead of abandoning this exploration as originally planned. The south cross-cut has entered trap after having been in 'rock' for 180 ft., but it will be continued in the hope that copper-bearing ground will be found again.

NEVADA

DESCRIPTION OF THE DAYTON DREDGE.

Dayton.—The new all-steel dredge, completed September 5, is now being operated steadily. It weighs 900 tons and has a nominal capacity of 7000 cu. yd. per day, although it is expected that uneven ground and boulders will limit its effective capacity to 5000 cu. yd. per day. While the dredge does not approach in size or capacity some of those operating in California, it is said to be the perfection of dredge design. It is the first in Nevada made of steel construction, and the first anywhere in which all the deck-plates are electrically welded. It has 9-ft. draft and was built in four months working time at a cost of $350,000. Some of the structural material was taken from two old dredges of the company near Marysville. The dredge floats in an artificial pond on a bench 30 ft. above the bed of Gold creek and within a few yards of the spot where gold was first discovered in Nevada. Placer-gold was found here by Mormons early in 1850 and the creek-bed was worked in a primitive way, part of the time by Chinamen, until 1859, when the placer miners working farther up the canyon discovered the Comstock lode. Placer mining was then discontinued, but in later years some small-scale hydraulic mining was done. The company has secured, under deed or lease, 700 acres, and has tested them by drilling and sinking shafts over 200 acres. It is said that the tests show an average gold content of 31½c. per cu. yd., and earlier tests and reports show 50 to 60c. Hydraulic washing of 24,000 cu. yd., several years ago, yielded 58c. per yard. The gold is coarse and many good nuggets have been found. Bedrock is from 14 to 40 ft. deep. Power is secured from the Truckee River hydro-electric plants supplying this region, and water from the Marlett Lake flume supplying Virginia City. The water is taken from the reservoir at the south of Mount Davidson and runs down American canyon to Gold canyon, whence it is carried in a 6-in. redwood pipe to the dredge.

Ely.—The first secondary-enrichment contact-deposit of sulphides of economic value developed in the Nevada Consolidated has been opened for a length of 60 ft. on the 700-ft. level of the Ruth mine, according to C. B. Lakenan, general manager. The ore contains 7% copper and it is reported that since the official statement was made the drift has been extended to 100 ft. and a cross-cut has been started to determine the width of the ore-body. This is the extension of the orebody on the 500 and 600-ft. levels, where the average copper content was 2½%.

Pioche.—Shipments have been made from the district recently at a rate of 11,000 to 14,000 tons monthly. During the past two weeks the Prince has shipped 3850 tons; Virginia Louise, 1150; Bristol, 350; Con. Nevada-Utah, 200; Black Metal, 200; Combined Metals, 200; Ida May, 40. Drifts have been driven to a total of 50 ft. from the bottom of the 75-ft. shaft sunk by lessees on the Burke mine of the Amalgamated Pioche. Ore was found in the shaft at 65 ft. and the drifts are being driven in ore. There is a rich seam 8 to 10 in. wide in both drifts that assays 0.18 oz. gold, 72.5 oz. silver, and 52.6% lead. The lessees have mined 25 tons of ore for shipment. The shaft will be sunk deeper and the drifts continued. The Bristol is making a production that last month reached 1000 tons from the Lloyd-Bent winze, at a depth of 800 ft. The contact of the ore, according to analyses made in Salt Lake smelters, is 0.02 oz. gold, 23.2 oz. silver, 12.5% lead, 3.3% copper, 6.7% zinc, 10.5% iron, 1.7% manganese, 1% sulphur, 23.5% insoluble.

Stonewall.—Because the Sterlag tunnel of the Yellow Tiger cost $30 per foot to drive, the company has stopped work until the cost can be reduced. Gordon M. Bettles, manager, says the cost can be reduced one-half by using a heavier drill, storing oil in large quantity, and other changes. The tunnel is being driven in monzonite-porphyry that is extremely hard.

Divide.—The Gold Zone has mined 60 tons of ore showing free gold from the vein cut recently on the 700-ft. level. This vein was found on the surface a year ago when holes were being dug for telephone poles. It was barren at 500 ft., but some of the ore being extracted on the 700-ft. level is reported to assay $150 per ton. The vein strikes directly toward the Alto, or at right angles to the main Tonopah Divide vein. Work has been resumed in the Alto and East Divide, on the 400-ft., or bottom,

level in each. The Alto was in ore on the 400-ft. level when work was stopped and a wide vein containing narrow seams of ore was being prospected at the same depth in the East Divide.

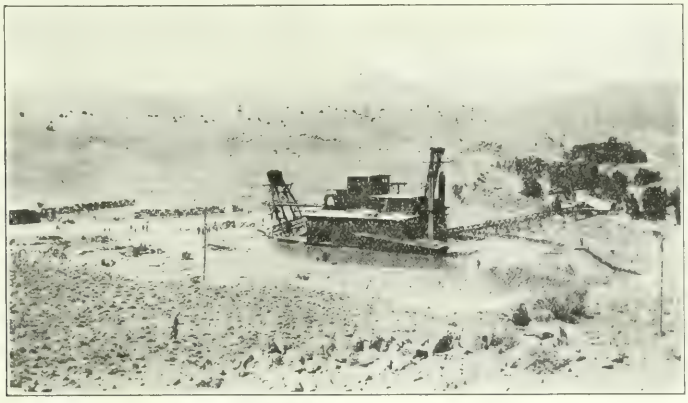
GOLDFIELD.—Report of the finding of an orebody in the Five to One tunnel, two miles south of the Florence, has brought hundreds of people to Goldfield from nearby towns in the last week. The report was untrue. A vein that outcrops on the hill into which the tunnel is driven was cut about 550 ft. from the portal. The foot-wall was entered and the vein has now been cross-cut 10 ft. without exposing the hanging wall. The formation is regarded as being promising and pannings of gold are said to have been secured in the vein. As the tunnel is in a part of the district where no work has been done at a depth greater than 50 ft., the Five to One has become the centre of interest. The Lone Star has given a permit for the erection of a Gibson mill to treat ore from the Meuli lease. The 3000-ft. shaft of the Deep Mines is to be three-cross-cut is the junction of the extension of the South West Comstock vein and a contact between limestone and granite.

ARROWHEAD.—Negotiations have been started for the consolidation of companies owning claims adjoining and near the Arrowhead, Ely and Salt Lake City men to finance the deal, according to officials of the companies included in the plan. The Arrowhead has bought a 25-hp. hoist and steel head-frame, which will be in use by October, according to present plans. The Arrowhead is making regular shipments to the MacNamara mill in Tonopah, the ore coming from the 275-ft. level. The ore in a winze, recently started from the 100-ft. level, is 6 ft. wide and of this width 3 ft. is rich material that will be sent to a smelter.

UTAH

DALY-WEST AND JUDGE COMPANIES DECLARE DIVIDENDS

SALT LAKE CITY.—High honors were won by the



THE DAYTON DREDGE

compartment, instead of four, as was at first planned. Two of the compartments will be 4½ by 5 ft. and the third will be 5 by 7 ft. in the clear, so that a skip can be used in it if found advisable. The collar of the old shaft, from which sinking will be started after it has been enlarged, is being concreted and concrete will be used to retain caving ground in the shaft, but elsewhere timber will be used. The company has enough timber on hand to start work and the rate af which the work will continue will depend on the arrival of more, acording to H. G. McMahon, secretary.

CARSON.—The Nevada Protective, A. J. Canavan, superintendent, operating two miles north of Carson and eight miles from Virginia City, has started cross-cutting to the vein at a depth of 100 ft. The ore in the district contains gold, silver, copper, and lead. The first find was made in the South West Comstock, where a shaft has been sunk 210 ft. in ore worth from $15 to $20 per ton for a width of 4 to 6 ft., with assays of more than $400 from seams. The objective of the Nevada Protective Bingham team, composed of employees of the Utah Copper, Utah-Apex, and Utah Consolidated Mining companies, at the International Mine-Rescue and First-Aid Meet at Denver, September 9, 10, and 11, when the team tied for first place on artificial respiration work. The Bingham team lost in the drawing of lots and, consequently, must be considered second. Seventy-six teams, from all over the United States, Canada, and Mexico, were present at the meet, and fully 5000 spectators witnessed the events. The Spring Canyon Coal Co.'s team won the local prize as first from the State of Utah, while the United States Fuel Co.'s team was second. The meet was a great success, and did much to emphasize the importance of mine-rescue work in coal and metalliferous mines, as well as around mills and smelters.

PARK CITY.—The Ontario Silver Mining Co. has a force of men engaged in sampling the old mill dump, with a view to ascertaining the average value. If the returns are satisfactory, which it is confidently expected they will be, a method of working the dump will be decided upon.

There are several hundred thousand tons of material that will be workable. Report from the Park-Utah Mining Co. states that conditions in the mine are improving, but the great handicap is shortage of labor. Miners and shovelers are so scarce that it is becoming a serious problem how to continue operations. This is true not only at the Park-Utah, but at all of the other big properties in this district. Shipments from this district during the week ending September 11 totaled 1722 tons, of which the Silver King Coalition shipped 636 tons; Judge M. & S., 429; Ontario, 333; Daly-West, 115; Daly, 111; Naildriver, 50; and J. B. Ireland, leaser, 38. During the previous week 2186 tons was shipped. During a severe electrical storm on September 7 the transformer house of the Three Kings Mining Co. was struck by lightning, which set fire to it and completely destroyed the building and its contents. The destroyed transformers belonged to the Utah Power & Light Co. The Three Kings company was compelled to suspend operations for a period of ten days while new equipment was being installed.

Directors of the Daly-West Mining Co. and the Judge Mining & Smelting Co. held their regular quarterly meeting at Salt Lake City on September 15. A 25-c. per share dividend will be paid to the stockholders of the Daly-West company on September 30. This will call for the payment of $62,500, and bring the grand total of such disbursements up to $6,768,500. The directors of the Judge Mining & Smelting Co. declared a dividend of 12½c. per share, payable September 30. This dividend will total $60,000, and bring the grand total up to $2,550,000. George W. Lambourne, president and general manager of both companies, reports conditions at the mines as excellent. The electrolytic plant of the Judge company is producing premium spelter, assaying 99.94% pure, and it is expected that during the coming month a new high record for production will be established. It is intended to operate two units of cells in the future, instead of one unit, as heretofore.

Alta.—Mineralization of an important nature has been found in the 'Baby McKee' fissure in the lower adit of the Howell Mining Co.'s property, adjoining the Cardiff mine. About 18 in. of mineralized matter, showing iron sulphide, manganese, and low-grade lead ore has appeared in the face of the adit, according to H. J. Deming, secretary and treasurer. The lower tunnel is now in a distance of 2000 ft. For most of the way the tunnel has been in a hard quartzite. In several places, streaks and stringers of good ore have been opened up, some of which have assayed as high as 36 oz. silver, 10% zinc, $1.50 in gold, and 28% lead. Recently conditions in the tunnel have been peculiar. The formation is quartzite, and in places the fissure, which takes an irregular course, is several feet wide and at others only a few inches. At present the face of this tunnel is about 300 ft. below the place where high-grade ore was found in the early days.

Eureka.—Work is progressing satisfactorily at the Eureka-Lily mine, according to Grant H. Snyder, manager. In the drift headed south on the 1840-ft. level to tap the ore-shoot developed on the 1640-ft. level, bunches and stringers of ore have been continuous for a distance of 150 ft. The ore-shoot on the 1640-ft. level was 250 ft. long, and a winze disclosed that mineralization improved with depth so the management decided to develop the same shoot on the 1840-ft. level. At the Tintic-Paymaster property, the work of cutting out a station preparatory to sinking a winze from the 400-ft. level, is nearly completed. The sinking of the main working-shaft at this property was discontinued on account of the heavy flow of water encountered, and a tunnel several hundred feet long was run on the 400-ft. level. The point where the winze is to be sunk is about 500 ft. from the shaft, and is in a limestone formation, which should carry no water.

During the week ending September 11, the Chief Consolidated shipped 29 cars of ore; Tintic Standard, 25; Dragon, 17; Mammoth, 12; Eagle & Blue Bell, 11; Iron Blossom, 10; Iron King, 6; Bullion-Beck, 6; Swansea, 6; Grand Central, 4; Gemini, 4; Victoria, 3; Centennial-Eureka, 2; Alaska, 2; Empire Mines, 2; Eureka-Hill, 1; Ridge & Valley, 1; Griggs-Huish Leasing Co., 1 car of concentrate; making a total of 142 cars.

H. G. Snyder, an official of the Tintic-Union company, owning ground in the eastern part of the district, states that work is to be taken up at an early date. The company recently levied a small assessment which will give ample funds for immediate needs. Some work will be needed in order to hold the claims for the present year, and officials state that they intend to sink a shaft in the near future. Recently the Zuma Mining Co. commenced drifting from the bottom of the winze which has been sunk about 100 ft. below the 800-ft. level. For the greater part of the distance the winze followed a small seam of ore and the same ore is exposed in the drift. The company is also raising from the 800-ft. level, where conditions equally as favorable exist. At the property of the Utah Zinc Co., situated in the Erickson district, west of this camp, ore is now being mined, according to B. F. Fleiner. The deposit is not large, but it is expected a larger vein will be found when the fissure is followed to the east-west break, a distance of only 50 ft. At present there is only a small force of men employed, but it is the intention to increase the number to carry on more extensive development during the winter. George Wallace is in charge. Regular shipments are now being made from the property of the Imperial Lead Co., and about 10 tons of lead ore is being shipped daily. The ore is transported by motor truck to the railway siding at Sugarville, and its average content is about 45% lead, with a small amount of silver.

Ophir.—J. W. Cairns, one of the large stockholders in the Eureka-Ophir Mining Co., having valuable property in the Dry Canyon section of this district, announces that work will be undertaken again on company account. Mr. Cairns stated that the first work will be to clean out the workings of the property, which are in a run-down condition as a result of the leasing operations that have been conducted during the past few years. It is the intention to install a new hoist, compressor, and such other equipment as is necessary for steady production.

BRITISH COLUMBIA

DECISION AGAINST GRANBY COMPANY IN CASSIDY COLLIERIES LITIGATION.

VICTORIA.—The Supreme Court has given judgment for the plaintiffs in the suit brought by the Esquimalt & Nanaimo Railway Co. against the Granby Consolidated Mining & Smelting Co. for the coal rights in the area known as the Cassidy Collieries. The decision permits the Granby company to continue operations pending appeal which has been taken to the highest Dominion court and will finally be referred to the Privy Council. Final decision is expected next spring. The suit involves the legality of the grant by the British Columbian government under the Provincial Settlers' Rights Act, which was disallowed by the Dominion government after the grant was made. The Granby company has spent a million and a half in the development of these coal deposits and in building the town of Cassidy. The suit, however, does not involve the surface rights, and there will be no diminution of output until final judgment is rendered. This is important because of the decreased output of the Vancouver Island collieries which was 117,194 tons for August as compared with 140,512 tons for July.

STEWART.—At the meeting of the local branch of the Canadian Institute of Mining and Metallurgy, held here on September 1, E. E. Campbell, assistant manager for the Granby company, in an interesting paper on mining cost, stated that ore was being mined more cheaply at Hidden Creek than at any other mine in Canada. P. E. Petersen, manager of the concentrating department for the Granby company, described a flotation cell of his own invention that is giving good results on Hidden Creek ore. According to G. A. Young, road superintendent of the Atlin district, the bridge over the Bear river, at Stewart, is nearing completion and will be in operation shortly. Two miles of the road to the Stewart-Premier mine was washed out, and repairs are being pushed as rapidly as possible. He attributes the comparatively slight damage in the Alice Arm district to the wing-dam which the Government built recently to provide against such a disaster. The Granby company is planning the re-opening of its Midas mine, on Valdez peninsula. The mine contains fairly high-grade copper ore, but, on account of the long haul, it is proposed to concentrate before shipping.

SANDON.—L. H. Biggar, a metallurgist of Montreal, who recently purchased Pat McGuire's interest in the Ottawa mine lease, has started the construction of a 50-ton concentrator. It is hoped to get the building finished before the snow comes, and then the heavy machinery will be hauled to the mine over the snow later. The Ottawa mine, which is situated at Slocan City, used to be owned and operated by the Consolidated M. & S. Co. Last year the company leased the mine to Pat McGuire and A. L. McPhee, who shipped 377 tons of ore to Trail. Much of this was derived from picking over the old dumps. The Rambler mill has been re-started, after several months of idleness caused by the activity of the 'One Big Union'. The men now employed at both mill and mine are affiliated with the 'International Mine Worker's Union'. A new tunnel is to be driven on the Last Chance claim. The old Payne mine, which was one of the first mines to be operated in the Slocan, has been abandoned to a Seattle syndicate. It is understood that no cash has passed, but that a stipulation has been made that a definite amount shall be expended each year for four years and that 15% royalty is to be paid on all ore shipped. The upper part of the mine has been worked out, but the vein has been cut by a tunnel at a depth of 1500 ft. and little exploration has been done at this point, so the new syndicate will commence operations at that depth.

TRAIL.—The Consolidated Mining & Smelting Co. has declared the usual quarterly dividend or 2½%, payable October 1. The disbursement will amount to $261,936 and will bring the total disbursement to $7,121,083. During the week ender September 7 a total of 7718 tons of ore was received at the smelter, the Consolidated company's own mines contributing 6946 tons. The other

DOME MINES, LTD., ONTARIO

shippers were: Emerald, Salmo, 45 tons; Josie, Rossland, 170 tons; Mandy, Le Pas, 371 tons; Nettie L., Gerrard, 18 tons; North Star, Kimberley, 125 tons; Payne, Sandon, 9 tons; Providence, Greenwood, 72 tons; Skylark, Greenwood, 16 tons; Taltarpin, Taltarpin, 4 tons; and Velvet, Rossland, 27 tons.

Dolly Varden.—On September 10 this mine had shipped just over one million ounces of silver. In 1919 the production was 426,000 oz., the remainder having been shipped since June 17 of the current year. About 20 tons of 1000-oz. ore is being produced each month, the valuable minerals being native silver and argentite. Besides this high-grade stuff, the mine is yielding 235 tons daily of 37-oz. ore. It is hoped that there will be interruption to shipments until about December 15, when the snow will render the railroad ineffective.

ONTARIO

DECREASED PRODUCTION DUE TO SCARCITY OF LABOR.

Toronto.—The Ontario government announces that it cannot at present see its way to build a branch railway from Swastika to open up the mining territory lying between Kirkland Lake and Larder Lake. Some time ago it promised to construct the line providing the companies interested would submit their properties to examination by government engineers and that the investigation showed that the resources warranted the outlay. The Associated Goldfields, the only company operating at Larder Lake, did not accept this condition, so the project failed. Now the Associated Goldfields declares its intention of building its own railway over a shorter route from a point at or near Boston Creek. The Kirkland Lake district has been supplied with a motor-road at a cost of $100,000, a means of transportation that many of the mine-owners preferred to a railroad. A highway is now being built in the eastern extension of the field.

Kirkland Lake.—The Kirkland Lake has cut its main vein on the 900-ft. level where it carries excellent ore with a showing of free gold. This working is the deepest in the district. The Buffalo-Kirkland has contracted for 1000 ft. of diamond-drilling to demonstrate the continuation at depth of veins uncovered on the surface. At the Wright-Hargreaves rapid progress is being made with the construction of the new 150-ton mill. Shaft No. 1 has been sunk to the 100-ft. level and the work of enlarging shaft No. 3 is in progress. Stopes are being cut at several levels in preparation for taking out ore. The Wood-Kirkland has brought in a boiler and hoist. The shaft has been put down by hand steel for 40 ft., the vein showing improvement with depth. At the King-Kirkland camp-buildings have been erected and a series of strong and well-defined veins opened up on the surface.

Porcupine.—A new orebody, of excellent grade and width, discovered by diamond-drilling on the McIntyre about 1600 ft. below the surface, is thought to be an extension of vein 84 of the Hollinger, which last year yielded 137,000 tons of ore. The output of the Hollinger Consolidated has lately been considerably curtailed by reason of a shortage of labor. Owing to many men having gone to help in harvesting, or to the lumber camps, the working-force has been reduced to about 900 and the mill is being operated at only half capacity treating 1600 to 1700 tons of ore per day as compared with the average for 1919 of 1950 tons per day. At the North Davidson where the construction of a steam-driven mining-plant has been completed, a vein on which a shaft is being sunk carries rich ore over a width of 4 to 5 ft. at a depth of 50 ft. The shaft will be put down to 150 ft. The main shaft on the Porcupine-Keora is down 250 ft., where cross-cutting has been begun to tap two veins indicated by diamond-drilling. The exploration of the north-west part of the North Crown property below the 1000-ft. level is proceeding rapidly. One hole is now 1600 ft. below the surface and has reached the Keewatin formation. The mill, which has a capacity of 150 tons, is running only at half speed owing to shortage of labor.

Cobalt.—Operators who, when the price of silver was low, were storing their bullion, are now shipping large quantities. The bullion shipments from the Nipissing and the Mining Corporation of Canada last week totaled 550,715 oz. The Nipissing during August mined ore of an estimated value of $238,959 and shipped bullion and residue from Nipissing and customs ore, having an estimated net value of $701,981. A new record was made for the low-grade mill which treated 7691 tons. The Crown Reserve is drilling a hole from the 500-ft. level that will reach a depth of 1600 ft. below the diabase. On its claims in the Gillies Limit the company has a shaft down 30 ft. on a cobalt vein with encouraging showings.

Cyril Knight, Ontario Government Geologist, is resurveying the geology of the Cobalt field. Work in the south-eastern part of Coleman township, including the Beaver and Temiskaming mines, has been completed and also that in the south-eastern part of Bucke township. Examination of the main part of the silver-producing area will be commenced immediately, but will be suspended during the coming winter with a view to resuming and completing the work in the summer of 1921. Bullion shipments reported from the Nipissing and the Mining Corporation for the two weeks ending September 10, amount to 449 bars containing 550,715 fine ounces.

For the first six months of 1920, silver production from Ontario decreased to $5,077,028, as compared with $5,951,362 during the first half of 1919. A further diminution is indicated by the present price of 94c. per oz. of silver, as compared with $1.17 for the first half of the year. The 'Beaver Lake' vein on the Keeley Silver mines, in South Lorrain, has been cut at a depth of 425 ft. The width and mineralization so far determined compares favorably with the upper levels, where a large tonnage has been blocked out. There the vein has a width of four feet and contains 40 oz. of silver per ton. Financial arrangements have been made to operate the Cane Silver mines, comprising 120 acres situated on the Elk Lake branch of the T. & N. O. railway. Spectacular patches of silver occur in narrow veins at the surface and an effort will be made to make a carload shipment.

ARIZONA

The Coronado mine of the Arizona Copper Co. at Metcalf, in which a series of fires has occurred during the past three years, is now operating successfully under mine-fire conditions. One of the interesting features in connection with the operation of this mine is that the crew of men are working daily in safety some little distance beneath the timbered mat which is on fire. The mine is a vein-deposit of great length and is said to be one of the longest productive veins in the West. The main working tunnels are parallel to each other and to the vein. The method of mining formerly employed was top-slicing and a continuous timbered mat approximately a quarter of a mile long and 35 ft. wide extended over the main workings. The numerous fires, presumably of incendiary origin, by which this mine was troubled, all occurred in the timbered mat. At first these fires were extinguished, but new ones started faster than the old ones could be put out, and the task of completely extinguishing them became impossible. Some method of operating the mine in safety under mine-fire conditions had to be devised. When this decision was reached last fall, the mine, which had been sealed temporarily, was re-opened very gradually. Blowers were used to force the air through iron pipe, past an air-lock of double doors, thus building up a pressure of fresh air which forced back the smoke and gases in the tunnels. After all the operating drifts and tunnels were cleared the gases were forced through the caved and broken ground to the surface, a distance of approximately 700 ft. An evidence of the strength of mine gases upon reaching the surface, after passing through 700 ft. of caved and broken ground, is that the miners on the surface were driven from their work on top of Coronado mountain and a burro grazing in the vicinity was killed. After the mine had been entirely freed from gas a high-pressure blower of 60,000 cu. ft. capacity was installed on the 700-ft. level in the main working tunnel, the station, of course, being placed so as to allow the passage of trains with supplies, etc. As all raises immediately beneath the fire were filled with ore and sealed, the air-pressure from the mine fan reached the extreme end of the workings, where it prevented the smoke and gases from entering the newer stopes which were about to be opened. The system of mining was changed from the timbered top-slice system to the shrinkage method. The stopes were opened in the extreme western part of the vein, which was a long distance from the blower, and as this part of the vein became exhausted, the old stopes were allowed to close and new ones opened, gradually working toward the fresh air coming from the blower placed at the eastern end of the vein. Every safety precaution is used. Should the power go off accidentally and the blower close down, a large air-valve is opened immediately by the fan-tender, which allows a large volume of fresh air to enter the workings and maintain the pressure for a sufficient length of time to permit the men to reach a place of safety. Systems of signaling by means of horns, and telephones are provided so that a direct means of communication is always available. Aside from the safety point of view, the provision of an abundant supply of fresh air, as well as an immediate means of communication with the men, is very desirable for efficiency.

CALIFORNIA

Amador County.—Under an agreement with the Argonaut Mines Co., whereby the latter will bear all expenses, the Kennedy has started unwatering its property. This work will greatly aid the Argonaut company in clearing the bottom levels of both mines and will facilitate resumption of mining in the deep Argonaut levels much earlier than scheduled. The Kennedy company recently suspended all work at its property because of the expense attending unwatering and the unfavorable position of the gold market. The Argonaut company is anxious to clear all its workings and resume mining on the 4800-ft. level, where high-grade ore was disclosed shortly before the fire forced flooding of the workings.

The extension of the main orebody of the Central Eureka, recently opened from the 3900-ft. level, is reported to be developing the same high-grade ore that was found on the 3750-ft. and other levels. The vein is several feet wide. Twenty stamps are falling at the mill and other units will be operated as soon as sufficient power can be obtained.

Nevada County.—It is estimated that the power restriction is causing the Grass Valley mining district approximate loss of $1000 per day in wages alone, as a result of the reduction in forces.

About 200 men were laid off. Their average wage was $5 per day. According to the district superintendent of the Pacific Gas & Electric Co., no relief is yet in sight.

The North Star Mines Co. is engaged in re-timbering several of the old shafts on its property, including the Massachusetts Hill and New York Hill shafts. These shafts connect with the Central mine and are used for air and for pumping. All represent former mines now consolidated with the North Star properties.

The Sultana Gold Mining Co. has a crew of men engaged in wrecking several old mills and hoists on its property, including the old Sultana plant and the Prescott Hill plant. These plants are largely obsolete and have been replaced with a single modern plant.

At the Idaho-Maryland efforts are directed during the shortage of power at holding the water, it being impossible to make any gains. The water-level is now mid-way in the old canyon shaft. The new plans of the company call for unwatering the entire mine.

Shasta County.—Erection of the buildings at Winthrop by the Shasta Zinc & Copper Co. is proceeding rapidly and before winter sets in the management will have an excellent camp firmly established. Most of the structures have to be moved to the present site from Coram. The mine is being actively developed and construction of a modern zinc-plant is to start in the near future.

IDAHO

Coeur d'Alene.—The Federal Mining & Smelting Co., owning several properties in the Coeur d'Alene, is removing good ore from its Morning mine. The Gold Hunter is employing more men. Two shifts are employed on the Midnight property where ore is being followed by raise. The Copper King is active. It raised 200 ft. from the tunnel-level but ran out of ore toward the top. The ore was recovered in a drift from the top of the raise and its appear-

ance is as good as in the raise. The American Commander is proceeding steadily with the exploration of its property. Work is being done on the surface and in a shaft with encouraging results. The company will add a compressor to its equipment in the near future.

That the rich ores of the Callahan-Zinc-Lead Co. in the Coeur d'Alene will go to a great depth is confirmed by the latest development, according to reports. The shaft is down to the tenth level, which is 1250 ft. below the main working tunnel. Cross-cutting to the vein is in progress and indications are that the same fine conditions will be found that were opened on the ninth level 200 ft. higher. The shaft is down to the level of Beaver creek and as the ore persists in the same large orebodies and of the same high quality, it is believed it will continue to much greater depth. One of the most important developments in the last year has been the building and equipment of the mill of the Nabob Consolidated Mining Co. on Pine creek. The mine is now operating with one shift, but will increase to full force in the near future. James Carney, veteran prospector and mine owner, who located the Carbonate Hill, Carney Copper, and Elizane Carney Copper properties 30 years ago, is still working the Elizane and says the Carbonate Hill, which he recently visited has a good showing for a big mine. He has started a lower tunnel on the Elizane Carney Copper Mining Co.'s property, which lies north of the Carbonate Hill.

Mullan.—"Highly encouraging conditions have been disclosed by the West Hunter Mining Co., one mile north of this place, in developing on the No. 2 level," says T. B. Cosgrove, manager. "The disclosure is contained in a streak of ore two inches wide opened at a depth of 100 ft. The width of the ore increased on drifting and at the face of the drift, 200 ft. from the place of beginning, is 18 in. wide. The average value is $31.70 to the ton, mainly in lead and silver but including $2.50 in gold. The vein is 10 ft. wide. The section of the vein containing ore should be reached in 200 ft. of cross-cutting on the main-tunnel level which is 850 ft. below the No. 1. Operations have been transferred to the cross-cut which is being advanced at the rate of four feet per day."

Wallace.—The ore in the new find at the Bryan has been cross-cut 15 ft., but the wall has not been reached. The entire 15 ft. is in good milling-ore. The Federal Mining & Smelting Co. has applied for a writ of certiorari, and if it is granted the Supreme Court will review the entire case of the Star Mining Co. against the Federal company. The Sunset mine is being unwatered to the 800-ft. level so as to permit access to the West Sunset. It is rumored that the Days may buy the Sunset from W. A. Clark.

NEW MEXICO

Pinos Altos.—The Hecla Divide Mining Co., which recently acquired the interest in the Langston mine formerly held by the Mexarco Mines Co., has a force of men at work repairing the mine workings for operation. H. F. Davis is superintendent.

MEXICO

Considerable interest is being evinced over the international exposition at El Paso, October 4. The principal officials of Chihuahua are expected to be present and several carloads of ore are to be shipped from the Chihuahua mines for the mineral exhibit which will be one of the best of the exposition. Parral, Torreon, and Durango will also be represented.

El Oro.—The Esperanza mine has recently cut the Descubridora vein on the fifth level. The vein at this point is four feet wide and assays 0.73 oz. gold and 38.48 oz. silver per metric ton. The manager stated in June that there remained about 1000 ft. on the course of this vein that had not been explored. Until this ore was found the mine had very little high-grade ore in sight and was depending on low-grade ore and old fillings which can only be handled on a large tonnage basis.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

George Alton has moved from Reno to Idaho Springs.

S. J. Lewis has returned from Zacualpan to Mexico City.

W. H. Harrison, of Washington, is at Duluth, Minnesota.

Bond Coleman has moved from Mexico City to Mound City, Kansas.

E. Wright Crow is now stationed at Metaquescuintla, in Guatemala.

H. H. Schlapp, of Melbourne, has been on a visit to his former home at Davenport, Iowa.

Otis D. Welsch is mill superintendent for the Saltchuck Mining Co., at Ketchikan, Alaska.

Scott Turner, after a visit to New York, has gone to The Pas district of northern Manitoba.

F. A. Dalburg, of New York, is now with the West India Oil Co., at Caracas, Venezuela, South America.

Gustave A. Overstrom sailed by the 'Tenu Maru' for Korea, in the interest of the Seoul Mining Company.

George Blagewitch, a Russian mining engineer from the Ural region, is visiting mining and metallurgical plants in Utah.

J. I. McGeorge, for a number of years past assayer for the Silver King Coalition Mines Co. at Park City, Utah, has resigned.

E. J. Raddatz, president of the Tintic Standard Mining Co. at Eureka, Utah, has been in southern California for a vacation.

Morris B. Parker has resigned as consulting engineer to the California Rand Silver Mining Co. and is now at Hollywood, California.

Francis B. Laney, of the U. S. Geological Survey, has been appointed Professor of Geology in the School of Mines of the University of Idaho.

Henry Leighton, professor in the University of Pittsburgh, has been examining pyrite and iron-ore deposits in the Algoma district, Ontario.

A. W. Beam, president and manager of the Benguet Consolidated Mining Co., sailed by the 'Tenu Maru' on September 18 for the Philippines.

H. G. Jenisen, of the U. S. Geological Survey, Washington, is in San Francisco for a month to investigate the copper-mining industry of the Pacific Coast.

Robert D. Longyear, geologist for the E. J. Longyear Co., has just completed a geological examination for the Yellow Pine Mining Co. at Goodsprings, Nevada.

Karl F. Hoffmann has severed his connection with the General Development Co. to undertake independent work with offices at 2 Rector street, New York.

S. F. Shaw has resigned as superintendent for the American Smelting & Refining Co., to become manager for the Compania Minera La Constancia at Sierra Mojada, Coahuila, Mexico.

E. Harold Walker, safety engineer at the Utah Copper mine, at Bingham, has resigned to accept a position with the Union Minière du Haut Katanga, at Elizabethville, in the Belgian Congo.

Raymond J. Poole, Professor of Botany in the University of Nebraska, has completed investigations, begun in May, of effects of smelter fume on plant life in the vicinity of the smelter at Murray, Utah.

J. E. Healey, general manager for the Consolidated Main Reef Mine & Estates, Ltd., Johannesburg, Transvaal, is at Los Angeles. He will visit San Francisco, Denver, and Chicago before returning to New York, whence he sails for London by the middle of October.

THE METAL MARKET

METAL PRICES

San Francisco, September 21

Aluminum-dust, cents per pound	**65**
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	18.75
Lead, pig, cents per pound	8.75—9.75
Platinum, pure, per ounce	$115
Platinum, 10% iridium, per ounce	$165
Quicksilver, per flask of 75 lb	$75
Spelter, cents per pound	**9.50**
Zinc-dust, cents per pound	**12.50—15.00**

EASTERN METAL MARKET

(By wire from New York)

September 20.—Copper is quiet and steady. Lead is inactive and weak. Zinc is dull but firm.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Sept. 14	94.25	60.25	Aug. 9	94.58	58.39
" 15	95.00	60.75	" 16	95.39	59.05
" 16	94.75	60.50	" 23	99.12	61.60
" 17	94.00	60.00	" 30	96.61	60.70
" 18	93.75	59.50	Sept. 6	93.27	58.90
" 19 Sunday			" 13	93.96	59.15
" 20	94.12	59.50	" 20	94.31	60.08

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	....
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Sept. 14	18.75	Aug. 9	19.00
" 15	18.75	" 16	19.00
" 16	18.75	" 23	19.00
" 17	18.75	" 30	19.00
" 18	18.75	Sept. 6	19.00
" 19 Sunday		" 13	18.75
" 20	18.75	" 20	18.75

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	....
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Sept. 14	8.25	Aug. 9	9.00
" 15	8.12	" 16	9.06
" 16	8.00	" 23	9.19
" 17	8.00	" 30	8.85
" 18	8.00	Sept. 6	8.55
" 19 Sunday		" 13	8.29
" 20	8.00	" 20	8.06

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	....
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Sept. 14	7.80	Aug. 9	8.12
" 15	7.80	" 16	8.27
" 16	7.85	" 23	8.42
" 17	7.85	" 30	8.45
" 18	7.85	Sept. 6	8.29
" 19 Sunday		" 13	7.78
" 20	7.85	" 20	7.83

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	....
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Sept.	
Aug. 24	80.00	" 7	75.00
" 30	85.00	" 14	75.00
		" 21	75.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	....
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

GOLD AND SILVER

By F. T. Eddingfield and F. E. Wormser

*With the price of silver higher than it has been for some 45 years, unusual interest arises regarding the position of that metal and its relationship to the present currency system. It is a well-known fact that a silver dollar does not contain the equivalent of a dollar's value in silver, and that the fluctuating value of the 374¼ grains of pure silver contained in each piece causes that coin to vary in value. In 1915 its bullion value amounted to 40.1 cents, and with the present price of silver around $1.23 the actual value of the silver dollar is 95 cents. Should the price of silver reach $1.2929 per ounce, the gold parity point will have been attained. An increase in silver value beyond that amount would give a purchasing power to the silver dollar greater than its face value. This might cause the stock of silver dollars to be melted into bullion and sold, but as relatively few silver dollars circulate little detriment to circulating currency would ensue.

The minor silver coins, such as dimes, quarters, and half-dollars, contain a smaller proportion of silver than the silver dollar and until the price of silver attains a value of $1.3823 per ounce (the gold parity point) no disturbance to that coinage is to be looked for.

The amount of silver in stock in the United States, on June 30, 1919, amounted to $552,214,591, against $745,747,094 on June 30, 1918. The decrease is due to the melting of silver dollars under the Pittman Act and the shipments of silver bullion from this country to Great Britain.

The amount of silver exported during the first eight months of this year is valued at $164,176,463, and of this amount the chief shipments were:

$108,877,478	to British India
24,960,880	" China
13,055,402	" England
6,588,197	" France
4,037,981	" Hongkong

and smaller amounts to other parts of the globe.

In August of a total of $13,808,877 in silver bullion exported, China's share was $10,911,987 and India's $604,301.

A considerable amount of silver has been imported since January 1, 1919. Of a total of $56,444,703 imported during the first eight months, $40,182,029 has come from Mexico, $5,465,971 from Peru, and $5,188,858 from Canada. The Central American States contributed $2,687,850 to the total amount. Mexico's August exportation was $7,364,892 of a total of $8,327,128 imported into the United States from various countries.

The exports and imports of gold exert a great influence over the foreign exchange-rate, which in turn determines in some measure for all nations where purchases of raw materials can be most advantageously made. Thus Italy finds that its lire has a greater purchasing power in Germany than in the United States.

MONEY AND EXCHANGE

Foreign quotations on September 21 are as follows:

Sterling, checks:	Cable	3.51⅜
	Demand	3.52¼
Francs, cents:	Cable	6.92
	Demand	6.93
Lire, cents:	Demand	4.40
Marks, cents:		1.77

*Issued by U. S. Bureau of Mines.

Eastern Metal Market

New York, September 15.

The markets are all generally featureless and quiet. The tendency of prices is downward if any change is recorded.

Buying of copper is very light, but inquiries from large consumers are increasing. Prices are easy.

The tin market has been quiet with buying only moderate and prices but slightly changed.

Lead imports continue to cause a softening tendency and prices are lower.

The zinc market is uncertain as to the future because of the improved situation. Values have declined.

Antimony is slightly higher but not active.

IRON AND STEEL

Business in general is very quiet. Traffic conditions are improving very rapidly and this is considered as the main reason why the Steel Corporation's unfilled orders as of August 31 showed a decrease for the first time in several months. The pig-iron market is stagnant. Buyers are not ready to take hold for next year and sellers are contracted for this year. It is believed that prices have marked their peak for this movement. What buying there is appears to be mostly in malleable iron in the Pittsburgh district. There has been some lifting of embargoes, which has benefited the Youngstown district, where pipe and wire products are most in demand. Demand for plates and shapes is light but consumers of nuts, bolts, and wire are active. The movement of coal is better, which is a source of satisfaction. Prices of coke remain stiff as output declines and car supply grows less. There has been a wage reduction in sheet-mill operation for the first time in a long period, due largely to a letting down in the automobile business.

COPPER

The market is lifeless as to actual business, but there are indications that buying by large consumers must set in soon. This is based on the fact that the latter are sounding the market frequently and in large numbers. The predicted buying movement is now set for the last of September or the first part of October. In the meantime large producers as a class do not have any set price. A few still adhere to the 19c. level, while some are selling at 18.75c., New York. In the outside market there are small producers and dealers who will take business at 18.75 to 18.50c., New York. In the mixed situation we quote the market for both Lake and electrolytic at 18.75c., New York, for September delivery, with 19c. asked for October and in some cases third quarter. Export demand is said to be very good. The July exports were 19,232 tons, excluding those to Canada, which should bring the total to over 20,000 tons.

TIN

The market is still quiet. The tin importers, to whom we referred a week ago, have continued to make some sales of future shipments to dealers and consumers, principally the latter, and the sellers are not reported as busy. In fact the most encouraging feature of the market has been the buying by consumers, among whom have been some large tin-plate makers, and this is felt to be significant. The tonnage involved is reported to have been considerable. On the New York Metal Exchange there have been further sales under the rule. Total sales for the week on the exchange have been about 250 tons. Spot Straits, New York, has been steady around 45c. and yesterday was quoted at 45c., New York. Arrivals thus far this month have been 2700 tons with 4675 tons reported afloat

LEAD

The market continues quiet. It is admitted even by some producers that demand is not heavy and that consumption is on the decline. The principal market even of the week was the reduction on Monday of the leading interest's price ½c. per pound to 8.25c., St. Louis, or 8.50c., New York. This was not unexpected by some, although declared unlikely by others, principally producers. The step was merely readjustment of the trust's price to the market-level, which has been lowered still further by imported lead. This has already amounted to at least 10,000 tons, it is stated, and sales have been made as low as 8c., New York, duty paid. In fact with exchange at $3.48 per pound sterling and the London price at £35 per ton, actual import cost with duty at 25% ad valorem figures at 7.40c. per pound, New York, which means a good profit. We quote the market as 8.25c., St. Louis, or 8.37½c., New York, for early delivery under present conditions.

ZINC

There are indications that the import situation is a factor and will continue to be a lessening factor and is nearly at an end. Re-sale metal from England is still available and at a lower level than a week ago. It is quoted at 7.75c., seaboard, for prime Western. The tone of the domestic market is better. There are more inquiries from galvanizers and some have resulted in sales at 7.85c., St. Louis, for early delivery. This would mean 8.30c., New York, with the cost of freight added. It is, however, possible for imported zinc to compete at Pittsburgh with prime Western at 7.80c., St. Louis, which appears to be the present market. The New York market may be quoted as 7.80c. on the basis of the import situation.

ANTIMONY

The market is quiet but strong. There are no features. Quotations for wholesale lots for early delivery are 7.12½c., New York, duty paid. Jobbing lots are ¼ to ½c. higher.

ALUMINUM

The feature of this market is the heavy offering of foreign virgin metal, which can be had as low as 30c., New York. The leading interest continues to quote the same brand at 34.90c. f.o.b. producer's plant.

ORES

Tungsten: No new business is reported but the outlook is said to be more promising. Prices are nominally unchanged at $5.25 to $5.50 per unit in high-grade ore, with Chinese ore at $5 per unit. For Bolivian, $6 to $7 per unit is asked.

Molybdenum: The situation is unchanged with regular concentrate quoted at 75c. per pound of MoS_2 contained.

Manganese. There are no developments. The market is quiet and easy. Consumers are apparently well stocked and are unwilling to pay more than 55c. per unit, seaboard, while sellers are asking 65c. Imports in July were 18,447 tons, or the lowest in several months.

Manganese-Iron Alloys: These markets are stale. There is very little inquiry and very little selling. The recent cut in ferro-manganese has caused consumers to wait, as usual. Quotations are unchanged at $170, seaboard, for British alloy, with American on the same basis. There are predictions that the domestic producer may cut the British price. Spiegeleisen is quiet but strong at $80 to $82.50, furnace, depending on the grade.

The Anaconda Copper Co. for the first time in its history is preparing for the recovery of lead in its Montana smelting plants. One of the old Boston & Montana reduction-works stacks at Great Falls has been converted into a lead stack for the treatment of the residue from the electrolytic-zinc plant and the lead recovered from these residues will form no small credit to operating expenses.

Book Reviews

Exporter's Gazetteer of Foreign Markets. Compiled by Lloyd R. Morris. Pp. 709, ill., index. Johnston Export Publishing Co., New York.

While primarily intended for the exporter, this book contains so much interesting and useful statistical and miscellaneous information regarding the countries of the world as to make it a valuable general book of reference.

A Spanish Mining Directory. By Adriano Contreras and Ramon Oriol, mining engineers. Vol. XX, 1920. Pp. 1300, cloth. Revista Minera, Metalurgica y de Ingeneria, Villalar 3, Madrid.

This book (in Spanish) bears the title 'Anuario de Mineria, Metalurgia, Electricidad y demas Industrias de Espana' and contains a classified list of all Spanish mines, mining and metallurgical companies, scientific societies, mining and civil engineers, copies of the mining laws, and much other information interesting and useful to those engaged in the industry.

A Vocabulary of Russian-English, English-Russian Mining Terms. By C. W. Purington and G. Toderovich. Pp. 126. J. B. Lippincott Co., Philadelphia. For sale by 'Mining and Scientific Press'. Price, $2.25.

This little book has been compiled largely as a result of Mr. Purington's engineering experience in Siberia. Most of the terms given apply to mining and geological subjects, but in addition some from mechanical, electrical, and chemical nomenclature are included as well as some relating to travel, law, and finance. The book is 3 by 4 in. and can be used conveniently and practicably by engineers whose work carries them to Russia.

Structural Steelwork. By E. G. Beck. Pp. 459, ill., index. Longmans, Green & Co., London and New York. For sale by 'Mining and Scientific Press'. Price, $7.50.

This is a bood book on structural-steel design and construction from a British standpoint, and an excellent one for a British engineer to buy. On the other hand, while the points of difference between American and British practice are relatively unimportant, nevertheless, they do exist. Consequently we do not believe, unless he wishes to inform himself of differences between practice in the two countries, that the American engineer will have much use for the book, well written as it is.

The Ownership and Valuation of Mineral Property in the United Kingdom. By Sir Richard Redmayne and Gilbert Stone. Pp. 256., ill. Published by Longmans, Green & Co., London. For sale by 'Mining and Scientific Press'. Price, $4.50.

This is an elementary treatise on the nature of mineral interests and royalties, and the correct method of valuing such property for the purposes of sale, probate, rating, and taxation, together with a statement of the law relating to rating and taxation. Sir Richard Redmayne formerly was Chief Inspector of Mines and is otherwise well qualified to write on the subject.

The Business Man and His Bank. By William H. Kniffin. Pp. 273, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $3.

Most books on banking are written for the banker or the bank employee. This one is written for the depositor and the borrower. Besides the ordinary commercial banks and savings banks, other organizations performing some or all of the functions of banking are discussed, although most of the space is naturally devoted to the ordinary commercial bank, or bank of discount. The important features of the various kinds of business that may be done between a bank and its depositors or borrowers are discussed in turn. The book will be of interest to anyone having dealings with a bank, and, particularly, to the man in business for himself.

The Oil Shale Industry. By Victor Clifton Alderson, Sc.D., President of the Colorado School of Mines. Pp. 175, ill. Published by Frederick A. Stokes Co., New York. For sale by 'Mining and Scientific Press'. Price, $4.

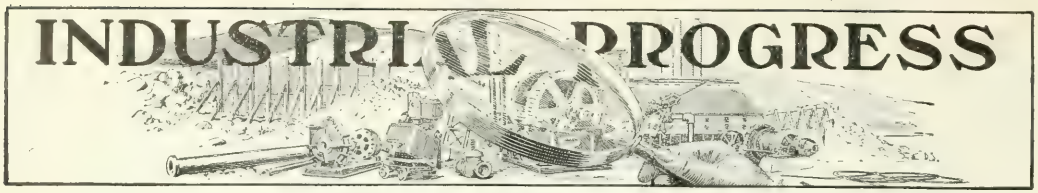
This is a timely volume on an interesting subject by a competent writer. It contains many valuable statistical, mining, and chemical data on the production and refining of oil-bearing shale. Nobody interested in the subject can afford to be without it. Although unduly optimistic in its appraisal of the commercial outlook for this new phase of the oil industry, the book is an extremely useful compendium of information on oil-shale. It is criticized by the editor on another page of this issue.

Tin, Sheet-Iron and Copper-Plate Worker. By Leroy J. Blinn. Pp. 319, ill., index. Henry Carey Baird & Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $3.

About half of this book is devoted to practical directions for cutting patterns for all kinds of sheet-metal work, and to a summary of the principal propositions of plane geometry of importance in such work. The rest of the book is a curious hodge-podge of mathematical tables, directions for tempering, receipts for varnishes, lacquers, cements, and solders, and considerable other miscellaneous information. There is a good index, however, which goes a long way toward making up for the lack of arrangement of the book itself. Furthermore, the material, although the arrangement is disorderly, is almost without exception of such a character as to be useful to the sheet-metal worker, who will find the book, in spite of its defects, well worth while.

The Iron Ores of Lake Superior. By Crowell & Murray. Pp. 300, maps and tables. The Penton Publishing Co., Cleveland, Ohio. For sale by 'Mining and Scientific Press'. Price, $5.

This is the fourth revised edition of this standard reference book on the iron-mining industry of the Lake Superior district. The material presented is a mixture of technical, statistical, historical, and commercial information that gives a comprehensive survey of the iron industry in all its aspects. Too frequently mining companies are unwilling or at least indifferent as regards the supplying of information relative to their operations. Fortunately those in charge of the mines on the iron-ranges appear to have co-operated splendidly in furnishing the data necessary for the preparation of this volume. One chapter describes a method of mixing ore for shipment, a process that requires increased attention as the better grades of ore are being depleted. This also involves systematic methods for recording analyses and this phase is treated in a separate chapter. The book contains maps of all the ranges, and it is further illustrated with vertical sectional views showing the geological formations of the principal ranges. The tables include the record of ore-loading docks on the Great Lakes, shipments from each range since its opening, prices of iron ore at lower-lake ports since 1855, rail freight-rates from the mines to lake shipping points, and cargo-rates since 1855.



INFORMATION FURNISHED BY MANUFACTURERS

THE DAYTON DREDGE

The Bethlehem Shipbuilding Corporation, Ltd., builders of the Dayton, Nevada, dredge, advise us that this dredge which started operations on September 6 is all-steel throughout, having a steel hull 108 ft. 5 in. long, 46 ft. wide, and 8 ft. deep; the buckets are 9 cu. ft. capacity and the dredge is designed to dig 39 ft. below the water-level. The machinery was made from parts from Marysville No. 3 and No. 4 dredges, with slight alterations. The revolving-screen is 6 ft. diameter and 38 ft. long, of the usual construction. The gold-saving table-area has been greatly increased over that of Marysville No. 3 or No. 4 and the distributing-box is of new construction, which will give better distribution of fine material.

All framing, including the housing, is steel throughout, and the covering is asbestos-protected metal so the dredge is absolutely fire-proof, no fire-insurance being necessary.

All deck-plating is electrically welded, this being the first dredge of the size, known to us, that has an electrically welded deck. The gantries have Bethlehem I-beams and girder-beams, which work in very nicely for this construction. The spuds are made of Bethlehem beams with cover plates, all bolted together.

Great care was taken in designing this hull and superstructure so as to give the maximum amount of strength with the minimum amount of weight. A considerable saving in weight has been made over the steel hulls of previous dredges of the same size.

'SURE SHOT' MINE-CAR COUPLER

The 'Sure-Shot' mine-car coupler is a new device manufactured by the Electric Steel Co. of Indianapolis. This coupler is coupled instantly by bumping the cars together after the outer link has been placed in position. The coupler is made of electric steel which has been heat-treated

and is practically indestructible according to the claims of the manufacturer. One of the features of the coupler is that it will act on sharp curves and uneven tracks and with a big saving of time. The safety feature of the coupler is also one of importance because by its use accidents in car work are reduced to the minimum. The design of the coupler is quite simple as will be noted by reference to the illustration. There is only one moving part and that is the drop-dog. The links and pins are all refined iron. The couplers are furnished complete with links and pins assembled and ready for immediate use. Holes for attachment to draw-bars can be cored or drilled to suit the requirements.

MINERS' SAFETY HAT

The miners' 'Hard Boiled' cap, which is being featured as a safety device by E. D. Bullard, of 268 Market street, San Francisco, has attracted the attention of the California Industrial Accident Commission and is made the subject of an article by H. M. Wolffin in a recent issue of the 'California Safety News', a paper published by the Commission.

Wolffin calls attention to the number of head injuries incurred by miners, steel erectors, shipbuilders, and workers in similar lines, and says that heretofore the only available protective caps were too expensive, too heavy, and too uncomfortable to be generally adopted. In the case of the 'Hard Boiled' cap, however, he points out that it weighs only nine ounces, that it is comfortable and inexpensive, and that it is a real safety device.

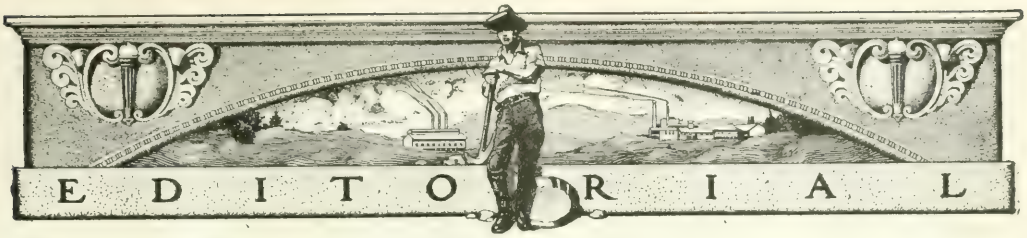
He cites a number of actual instances to prove that the cap is a real protection to workers. One case was where a twelve-pound joining-iron fell six feet, striking the head of a shipyard worker who was wearing one of the caps. The man was knocked to his hands and knees, but was not injured, and the cap was not damaged. Another case was at the Moore shipyards, where a four-pound piece of angle-iron fell twelve feet, striking a workman squarely on top of the cap. In this case, also, the man was knocked to his knees, but not injured.

COMMERCIAL PARAGRAPHS

W. L. Chandler, purchasing agent for the Dodge Sales & Engineering Co., is a candidate for the presidency of the National Association of Purchasing Agents.

At a meeting of members of the welding trade in Chicago, held in the rooms of the Western Society of Engineers, on Tuesday, August 3, a Chicago section of the **American Welding Society** was organized. There were about 75 in attendance, representing many railroads terminating in Chicago and also many of the larger local industries. The following officers were elected: chairman, M. B. Osburn; vice-chairman, O. T. Nelson; and secretary-treasurer, L. B. Mackenzie. Meetings will be held on the second Tuesday of each month in the rooms of the Western Society of Engineers and those interested in the subject of autogenous welding, by all methods, are invited to attend. The address of the secretary-treasurer is 608 S. Dearborn street, Chicago.

The new 'Eveready' instruction book, put out recently by the Oxweld Acetylene Co., 3640 Jasper place, Chicago, is one of the best treatises on every-day oxy-acetylene welding and cutting that has thus far been produced. Not since the company issued its 'Oxweld Manual', which has gone through two complete editions, has Oxweld experienced such spirited demand for a trade publication. The little volume is a compact and handy brochure (5 by 8 in.) containing 55 printed pages, inclusive of illustrations and drawings. It covers the field of everyday applications in a remarkably clear and concise treatment and in language that is easy for the beginner to grasp, and it is at the same time invaluable to the experienced welder and cutter. The booklet is distributed free.



T. A. RICKARD, - - - - Editor

EVIDENTLY the Australian author of the article appearing in our issue of September 18 was misled, by the position of a crane over the Marcy mills in the Inspiration mill, into supposing that this mill has to be moved from its bearings before it can be re-lined. This is not the case, and we are glad to make the correction, now that our attention has been drawn to the error. The re-lining can be done in place and without difficulty.

ON August 17 the twenty-fourth anniversary of the discovery of gold on the Klondike was celebrated at Dawson under the auspices of the Yukon Order of Pioneers. The occasion was rendered remarkable by the fact that it coincided with the arrival of four aeroplanes on their flight from New York to Nome. After all, there are things more wonderful than finding gold, even in quantity equal to a king's ransom. In 1896, when the squawman, George Carmack, stumbled upon the alluvial gold of Bonanza creek, the automobile was just coming into use. Flying ceased to be an eccentricity thirteen years later. What a difference aviation would have made to the Klondike rush of 1898! Undoubtedly if the discovery of rich gold placers were to be announced today from any remote or inaccessible corner of the earth, there would be none of the painfully laborious pilgrimage of former times, such as that which broke the heart and health of hundreds among those who climbed the White Pass above Skagway and trudged wearily to Dawson twenty-two years ago; instead there would be throbbing of engines in the air and the determined flight of planes across the waste of land and water separating the cities of civilization from the new Eldorado. We hope to live to see it.

TO the American miner it is almost annoying to read about the premium paid on the gold produced in other countries. Here is the Australian Gold Producers Association announcing that the total amount distributed among its members on account of the premium "earned" on gold exported from Australia since March last year is £1,064,646, "of which the greater share was credited to the Western Australian mines". "Earned" it, did they? It was a gift that they owe to a combination of circumstances, and more particularly to the appreciation of our good old dollar with that fine old bird, the American eagle, upon it, whereby it commands a rate of exchange that calls for 110 Australian shillings in lieu of the 84 that formerly sufficed. Pleasantry apart, we envy those Australians; what a bully thing that premium is! It sweetens the life of the gold-miner just at a time when he needs, and deserves, a cheerful tonic. We read further that "an interim dividend on the gold exported from Australia during the first quarter of this year amounted to £237,316". Whether the pound sterling be worth more or less, that dividend looks good to us. Curiously enough it is due entirely to the fact that the British pound is worth only $3.50 just now. "It is an ill wind that blows nobody good."

FLOTATION is not applicable to all ores. It is important therefore, particularly to those about to devise a metallurgic scheme, to ascertain to what extent the process of froth concentration is suitable. In this issue we publish an article that will aid anyone so situated. The testing of ores, for the purpose of determining their amenability to flotation, is discussed by Mr. James M. Hyde, now professor of metallurgy in Stanford university and formerly associated intimately with both the introduction of flotation into this country and the subsequent litigation over patent-rights. Professor Hyde has the art of exposition; he writes clearly; we feel sure that the suggestions he offers will be keenly appreciated.

SHARES of the Alaska Treadwell Mining Company have risen recently on the London market from 10 shillings to £2, a quadrupling of price since the slump that followed the collapse of the workings, due to caving and flooding, three years ago. As our readers are aware, most of the stock is held in London, a reminder of the time when the Exploration Company, under the leadership of the late Hamilton Smith, controlled the enterprise. The recent rise, it is interesting to note, is due, in part, to the buying of shares by people on the ground, that is, at Treadwell and Juneau, these purchases being stimulated by favorable news concerning the development of the group of prospects that the company has under option. This property consists of 31 mining claims on Roundabout mountain on the Nixon fork of the Kuskokwim river, at a place 35 miles from the little settlement of McGrath, which is a station on the Government wireless telegraph; the mines are 12 miles from the Kuskokwim river, a broad stream and navigable from this point to Bering Sea, which it enters below the little port of Bethel. Another way of indicating the locality is to say that the mines are 150 miles west of Mount McKinley. They have been taken under option for periods ranging

from four to five years, the optionees including not only the three Douglas island companies, namely, the Alaska Treadwell, Alaska United, and Alaska Mexican, but also the Bunker Hill & Sullivan company, which is under the same general management—of Mr. F. W. Bradley—as the three contiguous mines at Treadwell, on Douglas island. The claims are located on a limestone-granite contact for a length of two miles. Along this contact there is a lode-channel in which lenticular bodies of ore have been found. The ore is valuable chiefly for gold, but it carries two or three ounces of silver, and some of it contains from 2 to 8% copper. The surface is covered with moss and frozen mold—the tundra—as is usual in the North, so that prospecting is confined mainly to exploration underground by means of drifts and cross-cuts. Several lenses of ore have been disclosed; they consist of high-grade ore; for example, 38 feet assaying $56 and 32 feet assaying $65 per ton. A large proportion of the ore assays between $30 and $35 per ton, for a full stoping-width, but the orebodies are comparatively short, for example, 40 to 60 feet. The workings are only 100 feet deep as yet. The men employed are mostly the owners of the claims themselves; they constitute an excellent working force; 19 of them are engaged in actual mining, but this number is to be increased to 35. The latest letter received in San Francisco is dated June 4, which gives an idea of the comparative remoteness of the region. At that time the ice on the river was just breaking and snow was still on the ground. Mr. Livingston Wernecke, a competent geologist and engineer, is in charge of these operations. It can be said that the rise in the shares discounts the probabilities, but the venture is promising, and it is much to be hoped that it may give the Treadwell companies a new lease of industrial life.

MORE than 20% of all the taxes paid in the State of Montana during the last three calendar years was paid by the Anaconda Copper Mining Company, according to a recent statement by its president, Mr. Cornelius Kelley, to the Montana Bankers Association. There is material for thought in this fact and in the additional statement that the Anaconda company, the Montana Power Company, and the five railroad corporations doing business in the State, together pay 43.29% of all the taxes. This does not include income-taxes or taxes paid elsewhere. There are other corporations doing business within the State; in fact, a recent dispatch announced that the total assessment of the three big power companies (including the Montana Power Company) has been raised $4,000,000. It would seem that Montana is approximating that ideal socialist condition in which all the expenses of government are paid by the large corporations. According to Mr. Kelley, the Anaconda company has earned $494,317,000 within the confines of the State during the last eight years and has expended in Montana, for supplies, wages, and miscellaneous items, more than 80% of this total. He does not say how much of the remainder went for similar expenditures outside the State, and even socialists would have to pay for the use of money derived from exterior sources. Information like this is useful. We would like to see the Anaconda company issue a statement showing what proportion of the five hundred millions went to labor. We do not mean that item of the operating expenses which reads 'salaries and wages' and amounts to about 45% of the total, but rather that item plus all the other items that go to make up the real total, such as the item of wages in the freight charges, which amounts to about 50% of the cost of hauling the coal and coke, and the item of wages in the cost of the materials consumed in the hauling of the freight; and the wages in the original cost of the coal, which is about 75%. As an additional statement we would like to see the amount of dividends distributed to stockholders who are wage-earners. On account of the diversified interests and because it produces many of the raw materials used in its operations, these statements concerning the business of the Anaconda company should be instructive; they would, we think, have more value in counteracting I. W. W. talk than any dry argument based upon any bare economic theory.

Mining Finance

In this issue Mr. Robert S. Lewis, Professor of Mining in the University of Utah, discusses the principles underlying intelligent methods of finance, and their application to the business of mining. For success in politics, as we know, it is best to be born in Ohio, but to be successful in finance it is desirable to 'come from Missouri'. The sagacious citizen wants 'to be shown'; he eliminates the factor of uncertainty as much as possible, and if there be in his scheme or enterprise an element of doubt, as usually there is, he expects a return in proportion to the risk. In business, as in life generally, the first requisite is intellectual honesty, that is, an avoidance of self-deception. It is as sane to speculate as to invest, so long as the probable gain is proportioned to the probable hazard; that applies to mining, which usually is attractive to intelligent men because the danger of losing their money is compensated by the chance of a big winning. The same reasoning applies to the promoter. As Professor Lewis says, it is not wrong to offer stock in a gamble provided the conditions are stated truthfully. Even the wild-cat is a legitimate form of enterprise when its real character, as a risky venture, is set forth frankly. Misrepresentation is the essence of fraud. When a fiscal agent, as the shady promoter calls himself, represents a gamble in oil-drilling as "a manufacturing proposition" or a gold-mining prospect as "a gilt-edged investment" suitable for a ten-year lock-up, he is lying. Occasionally he believes his own lie because he has told it so often in highly persuasive language, but more commonly he lies with an unwinking eye. Professor Lewis gives avarice as the fourth cause of over-capitalization; but it is much more than that; it is the primal cause of shady finance. If people were not greedy as well as gullible there would be no need for blue-sky laws. These do not succeed completely in preventing the perpetration of fraud because no legislation will deter the fool from

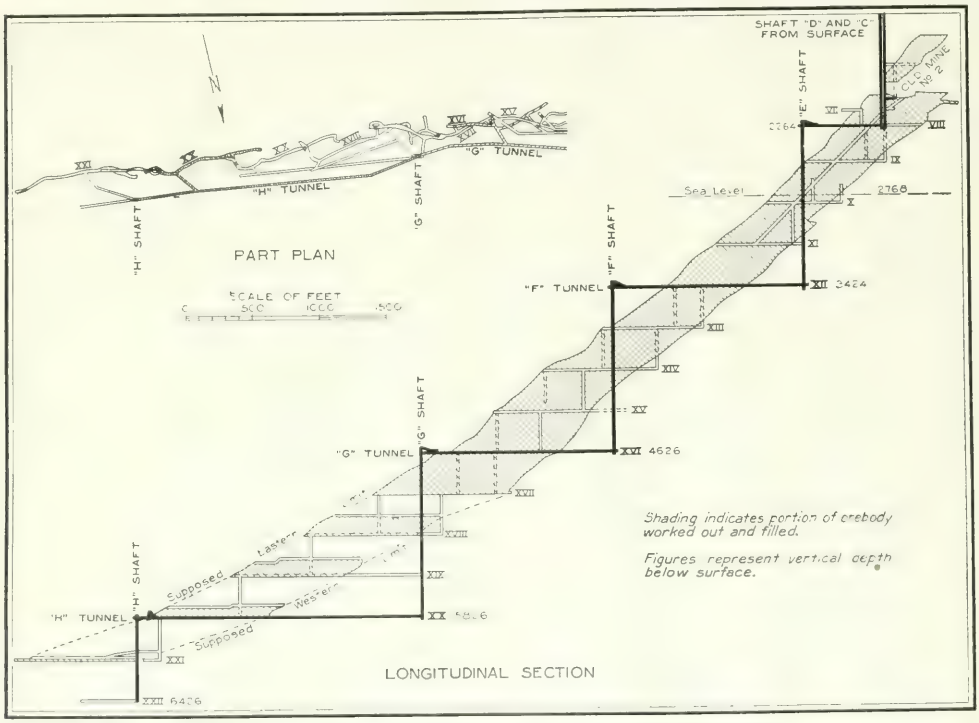
parting from his money, particularly when he expects something for nothing, that is, a big return for a small risk, a potentiality of wealth for a car-fare. Indeed the selling of stock at two or three cents per share is itself a fairly trustworthy sign of something wrong. It is bait, not fish. The issuance of low-priced shares is meant to catch people of small means; it should be discouraged, because people of small means should not risk their savings in ventures that are hazardous. They ought to put their money in a savings bank. Mining is for grown men, not widows and children; it is an adventure involving a risk that should be faced only by those not likely to be broken by failure; its rewards are to be won only by those able and willing to incur danger; it is profitable largely in proportion to the financial peril inseparable from an industry in which a factor of uncertainty is implicit. The wise man expects a return proportioned to the risk, the simple one ignores the risk and is content with a 'manufacturing profit'. For example, the promoters of the big mining companies of the Rand risked their money on a 25% return and then boosted their stocks until the dividends represented 6 or 7% on the market valuation, by which time they recommended them as trust investments for widows and orphans. The result was that the public got the stock at an inflated price, on which no real profit was possible, while the insiders retired into dignified opulence, solacing themselves with slow horses and fast women, while their successors endeavored vainly to justify expectations that were founded on falsehood. Such performances are not peculiar to Johannesburg, Hamburg, or London; we have seen them duplicated in this country; wherever and by whomever done, they are no part of legitimate mining, but parasitic growths upon an honest industry. The sooner they are recognized as thievery the better.

The Deepest Mine

The deepest mine in the world is the Morro Velho, a gold mine in the province of Minas Geraes, in Brazil. It has reached a depth of 6426 feet. This alone would make it interesting; but it presents other notable features, among which may be mentioned its continuous management by Mr. Charles Chalmers and the curious character of the mining methods by which it has been developed. The St. John del Rey Company, which owns this mine, was formed in 1830, ninety years ago. Mr. Chalmers has been in charge since 1884. The yield to the end of 1919 has been 6,940,000 tons from which £13,350,000 worth of gold has been won. An average of half an ounce is a sweet thing in gold mining. Last year the output was 166,000 tons, yielding 105,537 ounces, from which were paid dividends amounting to 10% on 546,265 ordinary shares of £1 each and 10% on 100,000 preferred shares of £1 each. The amount received as premium on gold was £61,635, which, however, was almost wiped out by the rise in Brazilian exchange. Owing to a war-time embargo upon exportation, the gold had to be sold to the Brazilian government, instead of being shipped direct to London. The increase of temperature in depth has been a serious obstacle to efficient labor and is rendered all the more serious by the indirect system of openings underground, rendering it difficult to establish a satisfactory system of ventilation. The accompanying section shows the step-like series of shafts and levels by which the bottom of the mine is reached. There the temperature of the rock is 117°F., and of the air 110°. When first entered the temperature of the rock at 6400 feet was 118°, as against a temperature of 65° at the surface, showing an increment of 1° per 121 feet of depth. The various efforts to mitigate the heat by vigorous ventilation have been handicapped by the extraordinary character of the development. The longitudinal section, given herewith, looks like a cross-section of a lode; indeed, the terms used in the annual report would readily mislead the casual reader, for we are told that the "lode" has flattened in "dip" from 40° at Horizon XVI to 19° at Horizon XXI. We have substituted the word 'orebody' on the section, which shows not the dip of a lode but the pitch of an ore-shoot. The dip of the lode that contains the ore-shoot is indicated by the plan; evidently it is nearly vertical. The best description of the Morro Velho lode is that prepared by the late Orville A. Derby of the Brazilian Geological Survey in 1901. He stated that the lode lies in calcareous schist and follows the almost vertical foliation, whereas the orebody follows a fault-plane inclining eastward at an angle of 45°. He talks of 'lode' and 'dip', and it is from him presumably that the mine officials obtained their incorrect terminology. It would appear that we have here an orebody lenticular in plan and funicular in section. Probably it occupies an acute torsional fold in the schist, where it has undergone such slipping and shearing as to create a channel for the circulation of mineralized waters. The ore is a massive mixture of pyrrhotite, with arsenical and common pyrite. Quartz is a subordinate constituent, as compared with most gold veins. The orebody has become longer and narrower in depth, being 1000 feet long and 12 to 15 feet wide on the lower levels, as compared with the nearly uniform length of 600 feet and the width of 45 feet exposed in the upper workings. Thus the accompanying section shows not a thick lode dipping at a lessening angle but a short and well defined orebody pitching strongly within an almost vertical lode-channel. It is an ore-shoot of a shape so well defined in length and so persistent that it might be called a 'chimney'.

The mine was worked first by means of a large open-cut, which eventually collapsed. Then two vertical shafts, 'C' and 'D', were sunk to 2264 feet, which is the level known as Horizon VIII. That was in 1892. Since then the mine has been developed, as the section shows, by a series of internal shafts, each 1200 feet deep, in step-like succession, the first starting 610 feet east of the 'C' and 'D' shafts, and each of the succeeding ones 1420 feet farther east, connected in turn by a level parallel with the orebody at a safe distance within the country-rock. Between Horizon VIII, 2264 feet below the surface, and Horizon XXII, at a vertical depth of 6426 feet, there are

four vertical shafts and four main levels, making a total connection very nearly two miles long. This, of course, is a most undesirable method of deep mining. It is obvious that the management has not been sufficiently confident of the persistence of the orebody to adopt a courageous and economical plan of development. It is proposed now to sink two shafts, parallel with each other and inclined at an angle similar to that of the orebody. These shafts will be 55 feet apart, centre to centre, and will start at the western, or inner, end of the orebody. The interval between levels will be, as heretofore, 300 feet vertically, which corresponds to 900 feet on an incline of 19°. It is intended to use a single-track tramway in the downcast shaft, with a loop arrangement at the point where the ascending and descending cars will pass each other. The upcast shaft from level to level will be used as one continuous shaft if it proves advantageous. From Horizon XXII to Horizon XXVI the length of the inclined shaft will be 3600 feet, but it is estimated that the cost of sinking will not be anything like as great as that of a vertical shaft sunk from the surface. At present the time lost by the men in walking along the levels and in traveling down the shafts is fully one hour per shift. This is a nice problem, and we submit it to our fellow engineers. Obviously it is easy to write last year's almanac, that is, to see the blunder that has been made. When the mine was young, it invited at least two other schemes of development. A vertical shaft could have been sunk through the eastern ground, to cut the orebody, say, at 5000 feet. Another plan would have been to start an incline from Horizon VIII, connecting with one of the vertical shafts, 'C' and 'D'. Such an incline could have been sunk at an angle equal to that of the pitch of the ore, which down to that depth had been remarkably regular. Lower down, owing to the flattening of the pitch, the inclined shaft would have passed out of the ore and under it, inviting a change of angle in conformity. It may be that owing to the character of the lode, it might have been advisable to sink the incline outside it, in the wall-rock. That would depend upon the relative hardness and character of the ground within and without the lode. Perhaps, for the sake of ventilation, it would have been desirable to sink an inclined shaft and connect it with a direct vertical opening. As we have suggested, hindsight is easier than foresight; we are disinclined to adopt a tone of patronizing criticism toward such a man as Mr. Chalmers, whom we respect greatly, but it is fair to say that the hand-to-mouth policy of the management might have given way to something better if one or more engineers with large experience in such matters had been called into consultation at least twenty years ago. In any event, the conditions at the St. John del Rey are unusual, if not unique, and they invite discussion.



THE MORRO VELHO MINE OF THE ST. JOHN DEL REY MINING COMPANY

Centrifugal Pumps

The Editor:

Sir—I should like to correct two errors in my article on 'Centrifugal Pumps' in your issue of July 17. The fifteenth line from the bottom of page 86 should read "gauge shows the static and friction heads in the . . .". The word "velocity" should be omitted, as the suction-gauge shows the velocity-head in the suction-pipe and this is the same in the discharge-pipe unless the discharge-pipe is of different diameter. In this case the correction for the difference in velocity-heads is made as indicated at the bottom of the page.

In line 5 on page 87 the words "per second" after 1.5 ft. should be omitted.

ROBERT S. LEWIS.

Palo Alto, September 10.

Dredging in New Zealand

The Editor:

Sir—We note in your issue of August 28 on page 324, an account of an American-made gold-dredge for New Zealand, which is now being built by us. In the second paragraph of the account it mentions that the "dirt is dropped on the conveyor-belt and is carried to the screen". This would rather indicate that it is a freak dredge, as such a method would be impracticable. The material is dumped directly into the screen and there is no conveyor-belt that enters into this part of the dredge.

The last paragraph states that "418,745 cu. yd: has been dug in a period of two years". This figure should have a naught on the right-hand side so that it would read 4,187,450 cubic yards.

We did not furnish these data to you, otherwise it would not contain the errors. If you care to make these corrections, we will be glad to have you do so.

New York, September 10. A. C. LUDLUM.

A Suggestion

The Editor:

Sir—The 'Mining and Scientific Press' has always taken a lively and progressive interest in the far too common disputes between capital and labor. This letter is written to suggest a solution that is not claimed as original, but that would be recognized as a distinctly mining contribution applicable to all industry.

This solution will not satisfy the professional agitator in the ranks of labor, who does not believe in the sacred and necessary right of private property, and who would abandon American ideals of liberty for Bolshevik ideas of license. Nor will this solution satisfy the profiteer, who believes that labor should only be paid as a commodity, governed by the law of supply and demand.

Consider a prospector as representing labor. He is grubstaked and provided with tools to work by a capitalist. The profits of the partnership are divided 'fifty-fifty', if the editor will permit me to use that expression. My proposal is simply that wages be very low, just enough to fill the dinner-pail, and that at the end of each year two dividends be declared, stockholders and employees on a 'fifty-fifty' basis. I claim that production would be increased enormously, and that this form of profit-sharing is the real American square deal for both capital and labor.

I can think of a number of objections, but believe none of them are insurmountable. A bare living wage plus the 'fifty-fifty' division of dividends would be a happy ending to our grave industrial troubles.

Seattle, September 7. HARRY H. TOWNSEND.

[Who is to define the "bare living wage"? Ideas on that point have changed greatly since the common laborer has begun to enjoy, or at least to buy, luxuries.—EDITOR.]

Baking a Gold Ore

The Editor:

Sir—I have read the article on this subject in your issue of July 17, and write to say that while making some cyanidation experiments recently I made observations similar to those of Mr. B. L. Gardiner. The ore was auriferous galena, with some pyrite, in a quartz gangue. About 40% of the gold could be amalgamated; of the remainder the galena carried three times as much as the pyrite. The heads assayed $105 per ton. When all the ore was crushed to minus 150 mesh with 75% of it passing through a 200-mesh screen the extraction by cyanidation in 96 hours was between 60 and 65%. If, however, the sample used in the experiment was baked so that the normal dove-gray color was changed to a light-brownish tinge, the percentage of extraction rose to 95% and better in a period of 48 hours, with no important increase in the cyanide or lime consumption. The heat was not high enough to roast the ore; in fact, I found that baking for two minutes was as long a period as was necessary. I take it that the heat develops cracks in the ore and permits a readier penetration of each particle by the cyanide solution. I found that however prolonged the agitation, within reasonable limits, the tailing could not be lowered in value to less than $2 per ton. This insoluble portion of the gold might have been contained as distinct entities

in such of the grains as were unaffected by the heat, but I am inclined to believe that this residual gold is mainly in solid solution in the galena, that is to say, it forms with the galena so intimate a mixture that the solvent action of the cyanide is practically impossible. The baking process is unlikely to be an economic one on low or medium-grade ores containing, as mined, a large amount of moisture. It seems most applicable to high-grade ores. Crushing could be done in water, the slime could be filter-pressed, and the discharge baked prior to cyanidation.

PAUL T. BRUHL.

San Juancito, Honduras, August 24.

Power Resources

The Editor:

Sir—The editorial entitled 'A Grievance', in your issue of September 18, calls attention to what is undoubtedly a just ground of complaint on the part of the mining companies of this State, and one of the unpleasant elements of the situation is the knowledge that comparatively a small part of the water-power available on the Pacific Coast has been developed for industrial use. Referring to the reports of the U. S. Geological Survey, we find that in the New England states, where there is 1,951,000 hp. available, power-plants have been erected with a total nominal capacity of 1,506,000 hp., whereas on the Pacific Coast, out of 25,850,000 hp. available, or 13 times the amount on the Atlantic side, we have utilized but little more horse-power than the Atlantic states. The figures reported show that the New England states have developed 77.2% of the maximum (not minimum) available, whereas the Pacific states have developed only 6.6%. It is generally assumed that one of the important reasons is the great difference between the maximum and minimum flow. The figures given by the U. S. Geological Survey do not warrant any such conclusion, the minimum quantities being 868,000 for the New England states and 1,504,000 for the Pacific states. One of the real reasons is the character of the loading. It seems probable that the peak-loads are much higher here than in the East. It is not practicable, of course, to use storage batteries when the regular load is at the minimum. Mme. Curie and others have shown the enormous amount of energy released by the disintegration of radium. If some other physicist will show how this energy can be utilized and at the same time how radium can be regenerated the power problem would be solved. Power-plants could then always be operated at the point of maximum efficiency, the manufacture of radium acting as a storage battery.

In default of this, why would it not be advisable for the large power companies to construct, through subsidiary or allied companies, large electro-chemical industries at favorable places, industries in which the expense for power is a large proportion of the total, and operate them in times of high water and minimum loading, the product being stored for use, as demanded, throughout the year? As an example, take the production of oxygen. Companies using oxygen in large quantities for welding purposes, such as the manufacturers of mining-machinery, shipbuilders, and fabricators of structural steel, might, with advantage to themselves, build a plant for the electrolytic dissociation of water, so arranged that it would operate only at certain hours of the day or would automatically be cut into the circuit when the amperage was below a given quantity. In the use of welding and cutting devices the greatest item of the expense for supplies is the freight on the containers, if oxygen or acetylene, and on by-product (lime) if carbide.

The use of powdered coal is developing rapidly and if more combination plants were built, greater advantage could be taken of cheap electrical power. The power companies give special rates to users whose load is uniform, and better ones to companies that can take their power requirements at a time of the day when the regular load is at or near the minimum. If the user should then build his plant so that his requirements would conform to this condition and the excess be taken up by steam-power from powdered coal the greatest economy would be obtained.

This is not all. The U. S. Geological Survey reports that the petroleum resources of the country will be exhausted in twenty years, but what real difference does it make? The coal resources are supposed to be sufficient for two thousand years and it seems probable that pulverized coal will be substituted for fuel-oil in many industries long before the twenty years has expired.

When fuel-oil is $2.50 per barrel a million British thermal units cost about 38c., and in the case of coal 38c. per million British thermal units would correspond to a price of $10.60 per ton (about). Gasoline at 30c. per gallon means $2.25 per million British thermal units. The use of pulverized coal is even more simple than oil, except in oil-engines, and there is no apparent reason why it cannot be adopted for automobiles. Of course for this purpose the use of gasoline is simpler and the small amount required causes difficulty in exact regulation of the charge of a single cylinder, but these difficulties undoubtedly can and will be overcome. Perhaps there will be a reversion to the old steamer-type, but more likely some kind of mixing-chamber will be used in which the coal is kept in suspension in air by violent agitation, the charge being drawn as a mixture of air and coal-dust, or perhaps a small gas-producer will be placed under the hood and the pulverized coal will be supplied by agencies as is gasoline. Of course the ash is a difficulty, but not necessarily an insuperable one, and at any rate the difference between 30 or 40c. and $2.25 is sufficient to warrant quite an amount of expense in development of some arrangement that will permit the use of these resources. The use of organic substitutes for gasoline on a large scale is not practicable because the world will soon need all the available soil for food supplies. The development by the Government's engineers of the mixed oil and pulverized coal seems a long step in the direction indicated and will probably soon be followed by others.

San Francisco, September 21. ENGINEER.

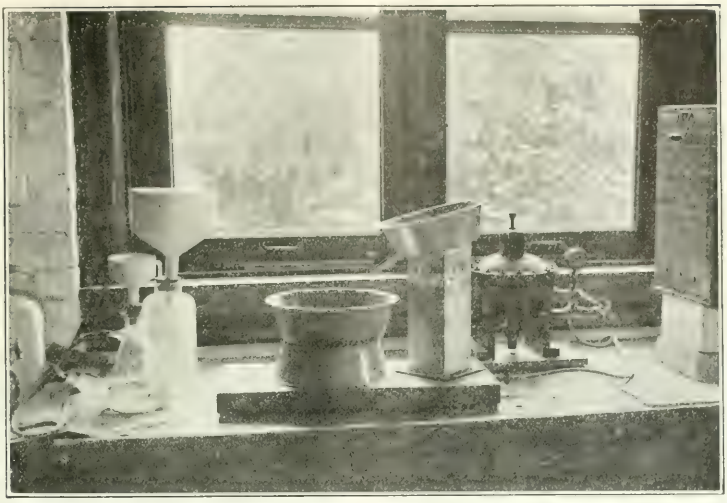


FIG. 1. PNEUMATIC TEST EQUIPMENT. FLOTATION MACHINE, REDUCTION VALVE, FILTERS, AND DRYING-OVEN

Testing Ores for Flotation

By JAMES M. HYDE

The factors involved in the concentration of ores by flotation are so few in number and so readily applied in a small way that it is possible to gain a fairly accurate idea as to the character of the concentrate that may be obtained by flotation, and even the total percentage of recovery that may be made by this process, by means of simple apparatus and small quantities of ore.

It may be the purpose of the testing to determine the character and value per ton of the concentrate that will be yielded if all the metalliferous constituents of the ore are recovered as a single product; to determine the percentage of recovery of the metals that may be won by the concentration; or to recover one or more of the metalliferous constituents of the ore in a concentrate separate from the others. This last—selective flotation—is capable of a degree of development requiring very careful selection of the flotative and modifying agents to be used, and will not be discussed at this time.

The recovery of the metalliferous constituents of the ore in a single concentrate is not a very difficult task if the ore is amenable to treatment by flotation, and any test by which the operator wishes to determine the general characteristics of the concentrate to be produced or the total recovery possible by floating all the floatable contents of the ore together may be made with some kind of standard mixture of oils and tars that will be generally applicable. Various oil-mixtures have been used for this purpose by different operators. I have found a mixture of three parts Pensacola Tar & Turpentine Co.'s No. 400 pine-creosote or its equivalent, three parts of carbolic creosote, and one part of crude coal-tar or pitch, makes a satisfactory combination for general testing purposes. For pyrite alone, the No. 400 pine-creosote is usually satisfactory. Others have found crude pine-oil plus 10 to 25% of crude coal-tar satisfactory.

The simplest apparatus for testing ores by flotation is a good-sized clear-glass bottle. A quart-bottle will do very well for 100-gm. samples of ore. An ordinary acid-bottle, such as those in which acids are sold, may be used on samples up to 500 grammes. To carry out the test, the bottle should be washed clean and half-filled with the crushed ore and water in the proportion of one part by weight of ore to from two and a half to four parts of water; using a quart bottle, a pint of water and 200 gm. of ore may be used and the test may be started with five or six drops of oil; using an acid-bottle, half a bottle of water and 500 gm. of ore make a good charge, and from six to twelve drops of oil are used at the start. After the oil is added to the pulp the bottle should be shaken violently with an up-and-down or horizontal movement and brought to a stop in a vertical position, using care to leave pulp as free from rotary motion as possible. If the ore is especially adapted to flotation and the correct amount and kind of oil have been used, a considerable portion of the metalliferous constituents should rise to the top of the pulp as a froth. After the slime has settled this froth may be removed by carefully raising the water-level in the bottle by adding water through a funnel, the lower end of which is below the water-level, or by pouring water carefully down the neck of the bottle.

The sides of the interior of the bottle should be wetted first by pouring clear water slowly into the neck of the bottle. After the froth has overflowed completely the bottle may be permitted to stand until the pulp is settled sufficiently so that the excess water may be siphoned off, oil-mixture to use in a mill or in more elaborate tests. It is also helpful in the field or in the mill, for arriving quickly at a qualitative test which will indicate the nature of the concentrate that may be obtained from any particular ore.

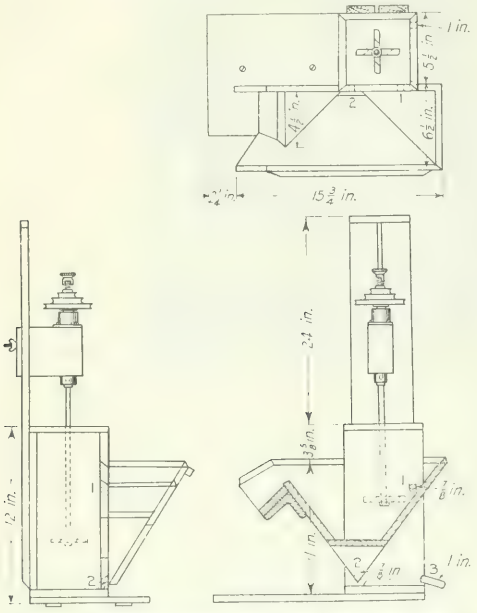


FIG. 2. DETAILS OF MACHINE FOR AGITATION TEST

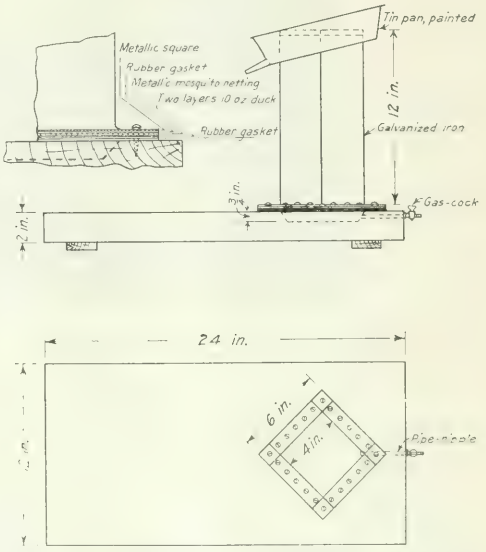


FIG. 3. DETAILS OF MACHINE FOR PNEUMATIC FLOTATION

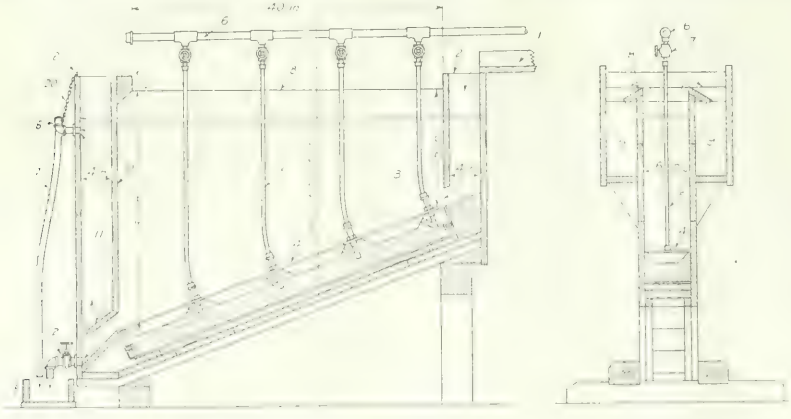


FIG. 7. PNEUMATIC MACHINE FOR CONTINUOUS TESTING

and the operation may be repeated with or without the addition of further amounts of oil. This operation may be repeated until it yields no more froth. The bottle-test may be repeated upon an ore, using one oil after another, until an oil or mixture is obtained that gives the best results. This test is helpful in selecting the proper

As a qualitative test it may be of a great value in the hands of the mill-foreman or shift-boss in testing the tailings from flotation machines or from vanners and tables, and in testing the overflow from de-watering devices, to see how much fine sulphide they contain. I have found this test very useful around plants. No equipment

is needed other than a clear-glass quart-bottle and a bottle of the oil or oil-mixture that has been found suitable for the ore, this bottle being equipped with a good drop-stopper. The type of bottle used for Welch's grape-juice, because of its shape and size, is particularly useful for collecting samples to be tested and for overflowing the concentrate most completely and quickly.

The bottle-test may be made to yield quick quantitative results of fairly reliable kind if it is manipulated skilfully, repeated agitation being used until no further concentrate is produced. A simple method of expediting the work is to take an india-rubber sack or 'baloon', such as is made for the whistles that delight children. If one of these, attached to the end of a glass tube, is introduced into the bottle after the agitation has taken place, water may be introduced into the sack through the tube and the water-level raised so that the concentrate overflows without the pulp being diluted. The rubber sack may then be emptied by siphoning and the operation may be repeated with the minimum loss of time. If a rubber bag is not available, a sheep's or pig's bladder might serve as a satisfactory substitute.

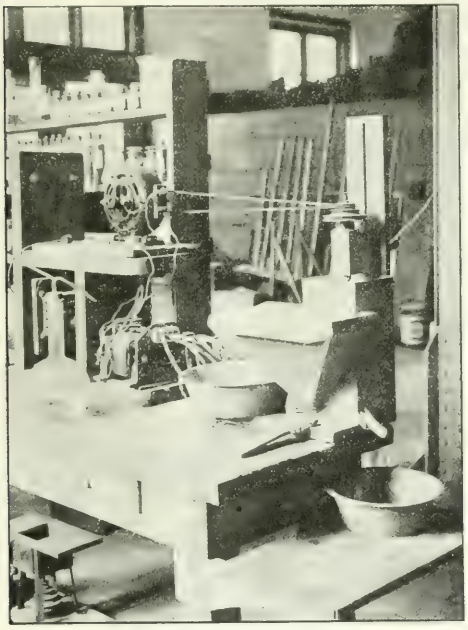


FIG. 4. AGITATION MACHINE AT WORK

On certain ores a modification of the bottle-test may be carried out effectively where the desired result is not a process to be used in practice but to get a quick idea of what kind of concentrate the metalliferous constituents of the ore will yield when separated from the gangue. The manipulation is as follows:

To the pulp in the bottle may be added from 1 to 10% of limestone, ground sufficiently to pass an 80-mesh screen. The oiling and the agitation may be carried on as before. A sufficient amount of sulphuric acid may now be added to start the generation of carbon di-oxide in the pulp, and the bottle may be filled with water so that the froth as it rises will overflow into the pan in which the bottle is set. By keeping the pulp stirred with a long rod or tube the sulphides may be completely removed by flotation, if the proper amount of the oil best adapted to the work is used. This manipulation requires some skill and is not recommended for general use; but, like the other bottle-test, it may be advantageous if no other equipment is at hand than that with which the bottle-test can be made. If the pulp is heated, or if the amount of sulphuric acid added is too large, the gas may be generated so rapidly as to expel the pulp from the bottle. For this reason, the acid should be added carefully, and with stirring, so that the generation of gas will be kept within bounds. The acid may be added before the agitation takes place if sufficient care be used, in which case the test may be completed more quickly than by any other means, as it may be possible to raise the concentrate completely at one time; but this is not recommended generally because the generation of gas may be so rapid as to throw the acid pulp out of the bottle onto the operator.

APPARATUS FOR PNEUMATIC FLOTATION. THE AUTHOR AT WORK

In carrying out any test in which acid is used in the presence of a carbonate, the mouth of the bottle should always be pointed away from the operator.

For making flotation tests by mechanical means, a simple apparatus will give reliable results with either the agitation or the pneumatic process. Many types of appa-

ratus have been used and described in the technical press, but the two described herein are so simple and have yielded such satisfactory results that I have come to rely upon them exclusively in my own work.

The machine for carrying out the froth-agitation flotation process consists of a rectangular box in which agitation takes place, and a pointed box in which the froth separates from the rest of the pulp. By reference to Fig. 2 the details of this machine will be apparent. The pulp is kept in continuous agitation and continuous circulation from the agitation chamber through an opening (1) into the separation chamber or spitzkasten from which it returns to the agitation chamber through the opening marked (2). The impeller has blades set at an angle of 45° from the vertical, and is placed about half-way between openings (1) and (2). The impeller is adjustable as to height and may be raised so high that the agitation chamber is completely open for inspection or cleaning. Ordinarily the impeller is adjusted until the best position is found and then left at that position.

The method of procedure in making a test with this machine is to close the opening (1) with a cork, introduce water up to a point just below this opening, and start the impeller. The dry ore is now added and mixed thoroughly with the water, water being added until the level in the separation chamber is about half an inch below the height of the overflow lip. The oil or oily mixture to be tested is added in the proper amount. Where a 500-gm. charge is used the initial addition of oil need not be more than from six to ten drops, unless previous testing has shown that as much as ten or fifteen drops are needed. The oil is added most conveniently by means of a 1-cc. pippette graduated to hundredths. After a sufficient mixing of the oil and pulp has taken place, which should be in about half a minute, the cork may be removed from the opening and the pulp allowed to circulate; from time to time, the froth floating upon the surface of the water in the separation chamber may be removed by a paddle and further additions of oil may be made in small amounts so long as they continue to produce more froth. After the last concentrate is removed, the tailing may be discharged through the opening indicated by (3). The machine is washed out conveniently by means of a stream of water from a hydrant or other source, carried through a rubber tube and a piece of glass tube 13 to 14 inches long, drawn to a tip at the bottom, and the tip inclined at an angle to the body of the glass tube, thus permitting a jet to be applied to the floor of the agitation chamber in such a way as to wash the sand to the discharge opening with the use of the minimum amount of water. After the machine has been cleaned thoroughly the concentrate may, if desirable, be returned to the machine and refloated in order to raise its grade, the tailing from this operation forming a middling product, which normally would go back into the tube-mill or other fine grinder, to be re-ground and returned to the flotation machine with the regular feed.

This machine is a slight modification of others that have been described previously, its chief individual merit being that it is driven from overhead, the height of the impeller is adjustable, and the settling-chamber is adequate, and is so arranged that the pulp circulates thoroughly without the use of any piping. The impeller in a machine of this type should be driven at a speed of 800 to 1600 revolutions; 1200 is usually about right.

The pneumatic machine shown in Fig. 3 is useful and can be constructed cheaply. It consists essentially of a wooden base into which is sunk a recess, to be used as an air-pocket into which air is introduced from some simple blower through a gas-cock and short nipple. Over the air-pocket in this base is placed, first, a square rubber gasket, then two thicknesses of 10-oz. duck or its equivalent, then a square of ordinary metallic mosquito netting, and a second rubber gasket, above which is mounted a square metallic cylinder open at each end (having a flange at the bottom as indicated and a basin at the top to receive the concentrate as it overflows), this basin being equipped with a spout by which the concentrate as it overflows is directed into the collecting-basin. That portion of the edge of the canvas which goes under the flange may be saturated with asphalt, care being taken that it does not permeate the portion of the canvas going under the inner portion of the cylinder. The cylinder is attached to the wooden base by a number of screws, and is screwed down in place so tightly that no air or water will escape through the edge of the canvas. The flange, which is made by bending up pieces of the sides, should be reinforced by a square with the centre cut out.

A test is performed in this apparatus as follows:

Five hundred grammes of ore is mixed with 1250 to 1500 cc. of water in an acid-bottle, which is shaken to wet the ore and make a homogeneous pulp. To this is then added from 6 to 15 drops of the oil or oil mixture to be used in the test. The pulp is shaken vigorously until the oil is well mixed with the whole of the charge, as previously described in the bottle test. The oiled pulp is now poured into the cylinder, the air is turned on and carefully regulated by the gas-cock so that the overflow of the concentrate will take place gently. This froth is overflowed until all of the concentrate the sample will yield has been produced. The tailing may be removed from the machine by tipping it up on the end of the base away from the air-intake while the air is still turned on, and washing out the contents with a jet of water. The concentrate may be returned to the machine and refloated as in the test with the agitation apparatus.

The pneumatic machine is dependent upon compressed air from some source. A small mechanical blower, such as the Crowell blower shown in Fig. 6, is useful for this purpose. Such a blower should be equipped with a pop-valve, which may be set for any desired pressure by adding or removing weights. Fig. 1, 4, and 5 show the machines described, as installed in a temporary laboratory in the Bureau of Mines experiment station at the University of California while war mineral-investigations were being conducted.

In preparing for flotation tests, a representative sample should be carefully crushed to such a size that even the coarsest piece of sulphide mineral will float readily.

In some ores pyrite is of little or no value, and it is often desirable to float other sulphides without floating the pyrite. Ordinarily, pyrite is tougher than the other sulphides, and it may be possible to determine a degree of crushing that will leave at least a portion of the pyrite too coarse to float, while practically all of the chalcopyrite or other sulphide that it is desired to save may be fine enough for successful flotation. If it is desirable to leave part of the pyrite unfloated, a test may be made upon ore crushed so that it will all pass through a 30 to 50-mesh screen. Ordinarily, where it is desirable to float all the sulphide constituents of an ore, the whole sample

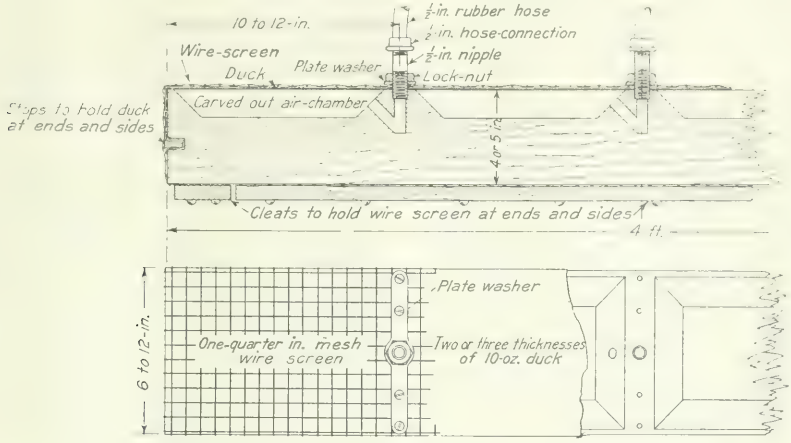


FIG. 8. DETAILS OF AIR-CELL CONSTRUCTION FOR PNEUMATIC TESTING

should be crushed so that it will pass through a 60-mesh screen. Even 100-mesh or finer gives the best results in most cases, especially for the bottle-tests.

In testing an ore for the purpose of working out the

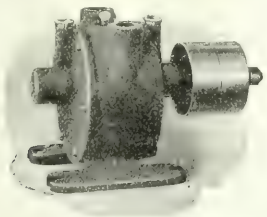


FIG. 6. THE CROWELL BLOWER

details of milling practice, the tests should be made upon samples crushed to different degrees of fineness in order to determine how fine it is necessary to crush to get the maximum recovery, and whether or not a finer degree of crushing is necessary in order to get the highest grade of concentrate possible.

The usual oils or oil mixtures used in flotation work include turpentine, crude or refined; steam-distilled pine-oil, and the whole range of products recovered by the destructive distillation of pine-wood, falling generally under the head of pine-creosotes and pine-tars; the creosotes and tars produced in the destructive distillation of hardwoods; the neutral and acid creosotes, and refined and crude tars produced in the destructive distillation of coal; and certain crude oils and petroleum distillation products. Qualitative tests may often be made with salad-oil, if nothing better is at hand. Small amounts of pine-creosotes and tars, hardwood-creosotes and tars, coal-creosotes and tars, may at a pinch be made by distilling pitch-pine, oak, maple, alder, etc., or coal-tar, in some simple retort.

The simple mechanical apparatus described herein will give satisfactory and reliable tests, but much of importance can be learned by the bottle-tests, and they may be constantly used to advantage around an operating mill.

The agitation and the pneumatic machines described herein are entirely adequate for making elaborate studies of flotation problems, changing all factors, such as kind and amount of oil, dilution of pulp, fineness of ore, the use of additional reagents, such as lime, ferrous sulphate, copper sulphate, sodium hydroxide, sodium sulphide, and sodium silicate. Where ore is to be ground dry and many tests are to be made, a quantity of the ore should be mixed thoroughly after grinding and screening, and portions of the pulp to be tested should be weighed out into a number of paper sacks to facilitate rapid work. Some ores do not float readily if they have been dried; so, in checking mill-work, the drying of ores and the grinding of them dry should be avoided.

Large Buechner filters, with filter-pumps attached, may be used where many samples are being handled. Where few samples are being handled and assays do not have to be made promptly a wick filter may be used satisfactorily. A single paper towel folded to about an inch wide and flattened with the end held by a wire paper-fastener may be wetted and one end put in the pan of concentrate, the other end being folded over the edge of the pan and brought down below the bottom of the pan.

Capillarity will remove the water at a surprising rate. With one paper towel I have taken off over 800 cc. of water in 24 hours. If the pan is set on the edge of a sink, the water may be allowed to go to waste as it is removed or it can be caught in a pan. When the sample is air-dry the concentrate on the wick filter may be brushed off. I have found this simple device very useful in removing water from samples of mill-pulp containing slime. Such a sample may be decanted after a reasonable length of time if a pinch of alum is added to it when it is collected. After all the water that can be safely removed is poured off, a further amount may be taken off with a wick filter and the pulp brought to a thick consistence ready to go into a steam-dryer or to be used for flotation tests. A large lamp-wick or a piece of cotton cloth rolled into a wick works well. The paper towel is particularly effective.

A cheaply constructed continuous machine of the pneumatic type can be constructed with a tank of wood or galvanized iron, the air-cells being carved out of a straight grained piece of redwood or pine timber. I have constructed such a machine according to the measurements shown in Fig 7 and 8 and have found it to be very useful in testing under mill conditions. The measurements given may be varied as desired. A machine 4 ft. long and 6 in. wide with two square feet of canvas surface was built some years ago for a total cost of less than $50.

This type of flotation machine was described in the 'Mining and Scientific Press' of August 5, 1916, and the following description is quoted with modifications from that article. See Fig. 7 and 8.

The body of the machine is a rectangular tank with a sloping bottom or false bottom, and overflow sides. One overflow side will do for testing. Pulp from the launder (1) enters the feed-chamber (2) and flows into the flotation-chamber, where it passes over the wooden air-cells (4), through the upper canvas surface of which compressed air is being forced. The air is supplied through the hose (5) from the header-pipe (6). Each air-cell is regulated independently by a valve (7). The air rising through the previously oiled pulp builds up a bed of mineral-bearing froth above the water-level; this froth flows continuously over the lip (8) and is carried away by the launder (9). The bed of fragile froth, which readily breaks down unless air is constantly bubbling up beneath it, is prevented from flowing over the tailing-discharge, where no air is rising, by a partition (10) that divides a dead-water space (11) from the frothing-chamber. The bulk of the tailing is discharged through the valve (12). The deflector (13) guides any bubbles carried toward the tailing-valve by the flow of the pulp back into the frothing-chamber. The deflector (14) causes a counter-current of froth to flow toward the feed-end of the machine. Slime-tailing flows through the opening (15) and the swing-pipe (16) and through the hose (17) and joins the sand-tailing in the main tailing-launder (18). The swing-pipe (16) may be fastened at any desired height by engaging the proper link of the chain (20) over the nail (21). When the valve (12) is set so that the valve does not permit quite all the tailing to flow through it, the position of the swing-pipe fixes the height of the water-level, which will not vary until the pipe is re-set.

The details of this machine are covered by my patent No. 1,296,190, but anyone who desires to build test-machines of this type for his own use has my permission to do so.

Some kinds of dust are much more dangerous than others, a notable example being the difference between the effects of coal dust and silica particles. The silica particles, when they enter the lungs, set up a fibrosis, or fibrous condition of the tissues, which lowers the resistance to tuberculosis; hence it is that men in metal mines are liable to contract the disease. But coal miners, who live in about as dusty an environment as could be imagined, seem to thrive on the air that they breathe. Formerly it was explained that the minute particles of silica or similar substances were hard and sharp, and therefore more dangerous. But the coal dust is also often hard and sharp. When silica dust is mixed with coal or clay dust it becomes relatively harmless. Medical men, seeking an explanation for this, have found that there is a difference in the manner in which the lungs rid themselves of dusts of different kinds. Silica dusts are retained by the lungs, while the coal dusts and soot seem to have some stimulating effect on the lung cells, and are promptly gotten rid of. In other words, when coal dust is breathed, it is coughed out again or otherwise ejected through the nasal or mouth passages; while silica dust remains in the lungs and tends to render them less resistant to infection by tubercle bacilli.

As a matter of fact, coal dust appears even to have a somewhat beneficial effect; coal miners as a class have a low tuberculosis rate. It is not known whether this 'good dust' has some peculiar antiseptic property, or whether it causes a biological reaction tending to aid him who breathes it in his resistance against tuberculosis. The practical application of these discoveries comes in the fact that it now is suggested that in order to avoid the bad effects of quartz dusts, the attempt be made—not to get rid of the dust, but simply to mix with it a neutralizing dust of the coal or soot nature. Probably it will be possible, by adding coal to the dust that cannot be disposed of otherwise, to render it harmless; and just as stonedusting is used in coal mines to prevent coal-dust explosions, so coal-dusting will be used in quartz mines to prevent miners' phthisis.—League of Red Cross Societies.

Recent experience of talc producers confirms the fact that the fibrous variety of talc, contrary to popular belief, is not always most desired by paint manufacturers. It is true that in certain types of paint fibrous talc is an advantage, but in other types it has the disadvantage of being too bulky for its weight. 'Heavy' granular tales are often specified by paint manufacturers as distinguished from 'light' fibrous talcs. Practically all talcs are fire-resistant and it seems probable that many of the tales on the market today could be used in paint.

Some Principles of Finance

By ROBERT S. LEWIS

Introduction. All sound finance should be conducted according to certain principles that are clearly defined, and disaster is sure to follow, sooner or later, any departure from these principles. The recent example of 'Ponzied finance', with his reported maximum assets of $4,000,000 and minimum liabilities of $7,000,000 illustrates the truth of the saying that a fool is born every minute. Ponzi's bait was the promise to pay something like 50% return in 45 days through an unexplained use of foreign exchange-rates. Just why the Government officials should have let this fleecing of the public continue for six months or more before taking action is yet to be learned.

A milder form of get-rich-quick scheme has been tried by some Eastern banks which have charged 20% interest or more for short-time loans. An interesting comment on such business methods was made by J. S. Williams, Comptroller of the Currency, who states in a report of August 10 that these high rates "have been one of the potential causes, rather than the result, of the unsettling of values in our securities market, and of the burdensome rates which our railroads and industrial corporations and other concerns and individuals of the highest credit have been requested to pay for new capital essentially needed for the country's development and well-being. . . . Able and thinking business men know that exorbitant interest-rates mean destruction in the end, to the detriment of all, and that stability and permanent prosperity can be assured only by fair and reasonable methods of the financial power."

The hope of getting rich all at once, of gambling and expecting always to win and let others lose, and, in some cases, the demanding of more interest than can be properly earned, have been potent factors in causing many failures, which have created in the minds of the general public the impression that mining is a gamble and not a business, and that, therefore, the recognized rules of finance cannot be applied in mining undertakings.

Intelligent investing in mining enterprises requires a knowledge of business principles that many investors do not possess and a careful investigation that very few seem willing to make. Just why a business man who would carefully investigate a new proposal in his own line of business will shut his eyes and blindly throw his money to the unscrupulous promoter of a flamboyant mining advertisement is a question that psychologists might find it interesting to discuss.

Capitalization. The methods of capitalizing business enterprises may be divided into four classes. This is only a rough grouping, and enterprises will be found that will occupy intermediate positions.

(1) Capitalization not based on value; its amount is consequently a matter of little importance. The nature of the enterprise is such that a determination of its value is impossible. An invention in its early stages is a good example. The inventor estimates that a certain sum will be needed to develop his idea and he tries to raise this amount. The invention may be successful and may prove highly profitable, or it may turn out to be of no value and not even patentable. The inventor may give a part interest for a lump sum of money. The capitalization merely serves to apportion the holding of the interested parties and is temporary in its nature. Its chief advantage lies in the fact that large incorporation expenses are avoided until some definite value has been demonstrated. Temporary organizations, when large undertakings are to be incorporated, are often capitalized in this way. The United States Steel Corporation was first organized with a capital of $3000. This temporary company controlled all options, contracts, and properties for about six weeks. Then the main company was formed and the capital was raised to over a billion dollars.

Close corporations, in which the capital stock is held by a few persons, are frequently capitalized without regard to value. One company doing a business of over $12,000 per annum was capitalized for $6000. Each of the three stockholders subscribed for $2000. The United Verde Copper Company may be considered a close corporation, as it has less than 20 stockholders. This company is capitalized for $3,000,000, and up to October 1917 had paid over $44,000,000 in dividends.

(2) Capitalization based upon present value. The capitalization of a new enterprise, well within ordinary lines of business, is a comparatively easy matter. A man may buy a lot, build a store on it, and begin business. The cash or other property put into the business constitutes the entire value of the enterprise and measures its capitalization. If a capable manager can be secured only by the offer of some stock in addition to his salary, this stock must be added to the capitalization. In the case of a corporation formed to take over an existing business, the purchase price plus a suitable working capital and a necessary reserve make up the capitalization. Promoters often take a business at one price and sell it at another, the promoter's profit being included in the new capitalization. If a promoter's share is not excessive, such a method is legitimate.

What is known as 'goodwill' is a factor that enters into the capitalization of going concerns. Goodwill may be defined as the profit-producing power of an established business in addition to interest and replacement returns on the investment. It is intangible, but is an asset of the business and should be included in any scheme of capitalization unless it is of such a nature that it will not remain with the business after a change of ownership. One

method of valuing goodwill is as follows: The net profits are capitalized at a selected rate. If 10% is determined upon, a business returning a profit of $6000 per annum would be capitalized at $60,000. All property values are deducted from this and the remainder is the capitalized value of the goodwill. Thus, if $40,000 constitutes the value of the property the value of the goodwill is $60,000 less $40,000, or $20,000.

In large corporations the issue of common stock is frequently based on goodwill. Preferred stock is issued to the full amount of the material assets. The dividend to be paid on this stock is deducted from the total net earnings, and the remainder, representing the earnings of goodwill, is used as the basis of the issue of common stock. For example, let the net earnings of a concern to be capitalized be $2,000,000 per annum. The value of the property is $15,000,000. Then preferred stock is issued to this amount. If 7% is paid on the stock, the amount of the interest, or $1,050,000, is deducted from the annual income of $2,000,000, leaving $950,000 as the basis for the issue of common stock. Assuming that 5% will be paid on this stock the issue would then be $950,000 at 5%, or $19,000,000. The total capitalization would be the sum of the stock-issues, or $34,000,000.

(3) Capitalization based upon future profits. In this case the profits are estimated; they are not an accomplished fact. If kept within reasonable bounds, this capitalization of profit probabilities is perfectly legitimate. The stock of a business that pays 7% dividends may sell at par or $100 per share, but a similar stock paying 14% will not necessarily sell for $200. It is more likely to be priced at from $170 to $180 per share. If the owners are considering a future sale of stock, and believe that the increase in earnings will amount to 7%, it would be legitimate for them to increase the capitalization 100%.

When inventions are capitalized it is customary to anticipate their earning power. An accurate estimate, of course, is impossible. The usual procedure is to estimate the earnings as accurately as is possible and then discount this figure by a safe margin, using the result as the basis for capitalization. This capitalization must be large enough to provide for all operating expenses, for any required sinking-funds, for stock-reserves held to meet future emergencies, and for such additional stock for the inventor as will fairly represent the value of the invention.

In enterprises that include a franchise among the assets, it is as legitimate to capitalize the franchise as any other property of the corporation. Assume that a group of bankers secures a 25-year franchise to build and operate a water-supply system. An engineering estimate of the plant is $750,000. This covers both pumping-station and the system of distribution. For safety the amount is taken at $800,000. A study of the problem indicates that 12% should be realized on this investment. The project would therefore pay $96,000 per annum. The bankers are entitled to 6% on their money, or $48,000. If a sinking-fund of $24,000 is set aside to amortize capital and to meet emergencies, the remaining $24,000 of yearly income can be attributed to the franchise. At 6%, this makes the franchise worth $400,000; consequently the enterprise would be capitalized for $800,000 + $400,000, or $1,200.000. This is not over-capitalization, since the amount is justified by the earnings. Mining companies are nearly always capitalized on the bases of future profit.

(4) Capitalization when the value of the enterprise can only be determined by development. In these cases the capitalization is fixed by more or less intelligent guesses. New processes, inventions outside the realm of experience, and mining prospects would come under this head. The actual value of the undertaking cannot be determined, so the promoters issue and sell stock for what they can get for it. It is not wrong to offer stock as a gamble provided conditions are truthfully represented. Misrepresentation of conditions constitutes the fraud in this case. A few men buy an acre of land in or near a well-known oil-field. The acre is divided into sixteenths. At the point where four tracts meet a well is started. Four companies may be formed, one for each tract, and stock is sold to the public on the strength of the advertisement that the X. Y. Z. company is sinking a well in a proved oil-field. The promoters reap a rich harvest and the public pays for it. If no oil is found, the performance may be repeated at some other point on the acre. The newspapers are full of advertisements of this kind. It is a safe rule never to buy because of newspaper advertisements. The game is always one of heads I win, tails you lose.

Over-capitalization. Capitalization that is in excess of the proper needs of the enterprise has caused the failure of many a meritorious promotion. The earnings were never adequate to pay dividends on the huge capital involved. In some cases of improper management dividends were paid that were never earned, the money being taken from paid-in capital that had been held in reserve. This point will be discussed more fully under the head of dividends.

Over-capitalization is generally due to one of four causes: First, fraudulent intent. Owing to the great risk of capitalizing nothing at all, some tangible property must be used as the basis of the promotion. Generally, the property selected is in such a remote region that investigation is either difficult or impossible. In other cases, the victims are swindled through property that could easily be investigated, but such an investigation is seldom made. The Royal Diamond Company operated on Wall Street and reaped a rich harvest until the authorities interfered. The company claimed to own valuable diamond mines in South Africa. Stock was sold for alleged development work. The board of directors, composed of titled Englishmen, banking references in different parts of the world, maps, and reports were pure fabrications. Nothing existed except the office furniture, the swindlers, and their victims.

A second cause of over-capitalization is the method of promotion. Showy offices, the payment of large commissions and salaries, and other concomitants of flashy promotion, leave little of the large capital subscribed to

be used in the legitimate development of the enterprise. Some years ago the promotion of a certain copper company was undertaken in this way. A dinner at $5 per plate was given by company officials to brokers and friends, expensive advertising literature was published, and development was started on a large scale. Examination of the property by competent engineers proved the existence of veins that contained good ore, but the faulting of the orebody had been extensive, thereby making the maintenance of a uniform daily output of ore a difficult matter. The enterprise dragged along for years and not a cent in dividends was ever paid. No fraud was intended, and the property had merit, but only the most competent management could make such a mine pay, and the margin of profit would be small in any case. Certainly, dividends could never be paid on the excessive capitalization. Spendthrift methods of promotion killed this mining venture.

A third and frequent cause of excessive capitalization is over-sanguine estimates of value. The inventor of a meritorious device receives a large sum for his invention. Unusually large royalties are also paid him, and he may be made general manager of the factory at a handsome salary. In this way money put into the enterprise is used up and business comes to a standstill until additional subscriptions can be obtained. Under this head would be included the cases in which the owner asks a fair price for his property but tells the promoter that he can have all the profit he can make above this price. The promoter then tries to secure such a large profit that the load imposed on the enterprise is beyond the possibility of any reasonable profit or dividend-paying possibility.

A fourth cause of over-capitalization is the avarice of owners. This is similar to the preceding case. A price beyond all reason is asked for the property, and there is no possibility that any profit can be made on such a heavy investment. Although not a cause of over-capitalization, the avarice of owners of mining prospects is one of the chief reasons why more prospects are not developed. The owners ask such unreasonable prices that mining and development companies that have ample capital to develop such possibilities are not willing to make the investment.

Amount of Capital. The total capital required for an enterprise may be divided into two kinds; fixed capital, or that invested in plant, real estate, and equipment; and working capital in the form of raw materials, stocks of partly finished goods, finished products not sold, accounts receivable, salable securities, and cash. Fixed capital is in forms that cannot be disposed of without breaking up the business. The proportion of working capital, in terms of total capital, that is required in some lines of business is much greater than in other lines. Telephone companies have large investments of fixed capital, but after the equipment is in place, operating expenses are light and can be paid by the monthly receipts; consequently, little working capital is required. On the other hand, a retail business in a rented store would have nearly all of its capital in the form of goods or working capital. Ample working capital is a necessity in any business. A concern manufacturing a patented device may have a large investment in plant and equipment. Sufficient working capital may have been provided, but later developments show that the device itself or the method of manufacture must be changed and, therefore, the fixed capital is wasted. A better procedure would have been to have some company manufacture the device under contract for a year or two and to devote the available capital to building up a strong selling organization until the best method of manufacture had been found. Then the additional capital needed for building the plant could easily be obtained.

For mining companies, the necessary investment in buildings and equipment can be quite satisfactorily determined. The working capital must at least be sufficient to meet the expense of development work, supplies, and payroll, until the product can be marketed. If the product of the mine can be sold within a short time, less working capital is needed than if the product must be carried for months before it can be marketed. Gold bullion may be sold at any time, but stocks of copper, lead, or zinc may have to be held for a long period of time in order to secure favorable market conditions. In the case of a company using a well-tried process of reduction, such as cyaniding, gravity concentration, or smelting, little is required beyond the fixed capital for the plant and a reasonable allowance for working capital. The method employed and the machinery used have been proved by experience and can be depended upon, but for new and untried processes ample working capital must be provided for making the changes that will certainly be required either in the process or in the plant and to cover breakdowns that will inevitably occur. A good example of the need for sufficient working capital is found in the case of a plant in which a leaching process was used for treating copper ore. The design of the plant was original with the metallurgist in charge. Nearly all the machinery was of special design and had to be made to order. This meant a long delay in getting the machinery on the ground. As soon as the plant was put in operation, trouble developed at many points; much of the machinery had to be changed; some was found to be superfluous and some had to be re-designed. This necessitated another long delay before operations could be resumed. The plant has cost several times the original estimate. Even in a plant using a well-tried process of reduction, there is a period of 'tuning up', or working the plant into smooth operation, that takes more time than was estimated and requires the expenditure of considerable money. More meritorious mining enterprises have failed through lack of adequate working capital than perhaps for any other reason.

A certain prospect has a promising appearance and a group of men organize a company to develop it. An estimate is made of the cost of plant and development. This capital is subscribed and work is started. The orebody had not been fully prospected, and the development work shows that mining will be more difficult than expected because of extensive faulting of the orebody. An expensive pumping-plant may be required to handle the

large flow af water developed on the lower levels. Damage to plant through fire or other accident postpones the period of production and calls for more capital to repair the injury. Several months of operation may be required before full production is attained. As a result, the owners have to pay assessments or become discouraged, and sell out at a loss. The property makes a successful mine in the end, but only when sufficient capital has been put into it.

Dividends. These are declared out of net profits by the board of directors. Once a dividend has been declared it becomes an obligation of the company and must be paid. Stockholders have no voice in determining the amount or time of dividends. The regular payment of dividends is desirable, and is considered an important principle of modern business finance. Most stockholders know little or nothing about the inner working of their company. They have bought stock as an investment and a regular income is desired. For this reason well-managed companies try to maintain uniform dividends. Profits vary from year to year and regular dividends can be maintained only by placing the rate at a conservative minimum. Whenever profits are great enough to permit of increasing the dividend, an extra dividend is usually declared. This dividend is often sent as a separate check, to indicate that it is an addition to the regular dividend and may not be paid again.

It is a serious mistake for a new company to declare dividends too soon. Stockholders frequently become impatient for dividends. They have been known to bring such pressure to bear on a board of directors as to force the board to declare a dividend sooner than their best judgment dictated. It takes time to develop a mine to a dividend-paying basis, and no intelligent investor should agree to a distribution of dividends until it is perfectly safe for the company to pay them. This premature payment of dividends has been the cause of much financial embarrassment. The payment of dividends should depend not only upon the profits earned but upon the financial position of the company as well. Working capital is reduced by the payment of dividends, and until a company is upon a well-established financial footing any impairment of working capital is dangerous. A satisfactory cash balance should be built up and this cannot be done if profits are paid out as dividends the moment they are earned. Fires, the caving of a part of the mine, change in the grade of ore mined, strikes, and other contingencies may arise. If no adequate cash-reserve is maintained an assessment must be levied or money must be borrowed to meet the emergency.

In some instances dividends have been paid from borrowed money. Though this is most always done for speculative purposes to keep up the price of stock, such a method is legal and may be justifiable for a company that faces wide seasonal fluctuations in earnings, but the wisdom of such a policy is open to question. Fraudulent payment of dividends out of capital has been known, but the directors are legally liable for such dividends. The payment of unearned dividends is due to ignorance on the part of the directors, or to their belief in large future profits, or to their desire to give the company a higher standing either on the stock market or with creditors than the earnings warrant.

Dividends from mining companies should be paid according to these business principles, but the investor in mining stocks should recognize the fact that his dividends differ from those derived from other industrial companies. A mine is a wasting asset. The orebody is not unlimited in size and every ton mined lessens the ore-reserve. When all the ore has been taken out of that particular mine it has reached the end of its life. Dividends from a manufacturing concern may be considered wholly as income, but dividends from mining companies should be considered as part income and part return of capital. If a mine has a life of, say, 15 years, enough of the dividend should be put into a sinking-fund so that it would accumulate to a sum equal to the purchase price of the shares at the end of the life of the mine. The remainder may be used as income. Should the whole dividend be spent as income, the investor would lose the purchase price of the shares, as they would have no value when the mine had been worked out.

In regard to the dividend-rate that should be expected from the investments in mines, the principle to follow is that the rate should be proportional to the risk involved. The greater the risk, the higher should be the rate. Government bonds or money in the savings bank may receive as low a rate as 3 or 4%, because of the safety of its position. A well-established manufacturing concern may pay 5 or 6%. Here, the element of risk is greater. A panic or some unforeseen contingency may cause a failure, but the danger is remote. At best a mining investment has a large element of risk attached to it and therefore the return should be proportionately great. For a proved mine that is well managed and has large ore-reserves, the rate may be comparatively low, say, 8 to 10%. Many engineers state that 10% should be the very least expected from a mine. Since this is not all income, as part must be used to replace the investment, 12 to 15% would compare favorably with, say, 7 to 10% in manufacturing or other industrial enterprises. For a mine in a foreign country the rate should be much higher. As high as 50% has been asked on investments in mines in foreign countries, where the mines were not fully developed though they were of great promise.

Form of Capitalization. When the amount of capital to be raised has been determined upon, it is necessary to select the form in which it shall be raised. The common forms are stocks and bonds. Bonds are really notes or promises to pay a certain sum at a specified date. They are usually secured both as to principal and interest by a deed of trust or a mortgage on real or personal property. Because of this safeguarding of the investment the interest-rate on bonds is comparatively low; 5 or 6% is a common rate for good bonds, though at the present time the rate may be 1% higher. In exceptional cases, where money must be raised on short notice, desirable bonds may be placed on the market at a rate as high as 8%.

To the promoter or organizer of an enterprise a bond

is the best method of raising capital. The interest-rate on the money borrowed is low, and large earnings can be used to pay dividends on the stock of which the promoter holds a large block. The bond-buyer surrenders all chances of a high return on his investment for the great safety involved. If necessary, he can foreclose and take over the property to his own advantage. If the stockholder receives no dividends and his stock drops to almost nothing in value, he is helpless unless he can prove that the management has been dishonest. However, certain enterprises do not make a good basis for bond-issues until they are well established, and even then bonds could be issued for only a moderate percentage of the value of the property. A mining company falls under this head. The usual method of raising capital for a mining company is by an issue of stock. The speculative appeal of such an issue is attractive to the public in that it offers a chance for large gains if the venture is successful. Bond-issues have been put out by mining companies. However, this is usually done by only the largest companies, such as the New Cornelia Copper Co., the Inspiration Consolidated Copper Co., the Kennecott Copper Corporation, and others that have ample material assets to serve as security for the issue. The tendency is for these companies to retire the bonds as quickly as possible, either by paying them off or exchanging them for stock. The New Cornelia Copper Co. is capitalized for $8,000,000 in shares of a par value of $5; bonds to the amount of $4,000,000 were issued to pay for equipment and construction work; these bonds were to run for 12 years and paid 6% interest.

The capital stock of a company is the total amount that it can issue under the terms of its charter, and bears no necessary relation to the amount of stock actually issued or subscribed for. A company may have a total capital stock of $1,000,000 and yet only half might be issued, the remainder being kept for later use. The outstanding stock is $500,000, but the capital stock is always $1,000,000. Dividends are paid only on issued stock. Unissued stock represents nothing but the right to issue. If sold it brings in cash but the stock carries with it an interest in the company that should equal the price received for the stock. Thus the increase in assets and liabilities is just equal.

Formerly the law required that all the capital stock must be issued and paid for, but now State statutes vary, and usually only part of the capital stock has to be paid up within a stated time. A share of stock represents an interest in the company, and its true worth depends only upon the earning power of the company. For this reason the face or 'par' value of a share has in reality little meaning, and speaking of stock as above or below par simply means that the financial condition of the company is considered to be either good or poor. A share is worth only its proportional part of the whole corporation no matter what the par value may be. There is a growing tendency to issue stock having no par value. This is a good plan as it would force an investor to investigate the financial standing of the company before taking an interest in it. The Minerals Separation North American Corporation was chartered in 1917 to facilitate the conduct of business in this country by the parent English concern; its capital consists of 500,000 shares of no par value, which were placed in a 5-year voting trust.

When capital is represented by only one kind of stock it is called common stock. Often the common stockholder is uninformed regarding the financial condition of his company. He has the right to vote for directors who are supposed to represent him, and his ownership of stock entitles him to his proportionate share of any dividends that may be paid. The company's reports may convey no real information concerning the condition of affairs. Recent court decisions make it possible for the stockholder to inspect the stock-ledger and transfer-books of the company for the purpose of getting a list of the other stockholders so that he can communicate with them. He also has a right to inspect the books of the concern when it is consistent with the interests of the company, but so many obstacles can be thrown in the way of such an inspection that this right can seldom be realized.

The idea that unissued stock is the same as treasury stock is prevalent, but incorrect. Unissued stock is merely the privilege of creating a liability. In one State the payment of $20 will charter a company and authorize an issue of stock up to $20,000,000. Such a company would have an over-supply of unissued stock, but no assets at all. When stock has been issued and fully paid for and then comes back into the treasury of the company, either through purchase or donation, it is rightly called treasury-stock and can be sold to bring in cash, for it has a definite value, yet it cannot be voted by the company nor can dividends be paid upon it.

Preferred stock is stock that is given some preference over common stock in regard to profits and often in regard to assets in case of liquidation of the company. Usually it is guaranteed as to dividends, and these dividends are cumulative, that is, if not paid when due the amount remains as a liability of the company and all preferred-stock dividends must be paid before a dividend can be declared on the common stock. It is often arranged that preferred stock is subject to redemption at a premium ranging from 5 to 20%. A common protection for preferred stock is the requirement that the company must maintain a certain ratio of current assets to liabilities, of net surplus to capital, and of dividends to surplus. In one concern, quick or easily realizable assets must be maintained at a minimum of $140 per share of preferred stock. Additional issues of preferred stock cannot be put out at more than two-thirds the cost of improvements and the increased capital. Preferred stockholders may have a right to vote. In some cases they come into control of the board of directors if dividends are not paid when due. Public-service corporations and industrial companys are more likely to issue preferred stock than mining companies. Preferred stock is sometimes issued by large mining companies, which control a number of mines or reduction plants, for the purpose of making extensions of plant or acquiring new property. The American Smelting & Refining Co. has a total capitalization of $115,000,000, which is divided into $65,000,000 of common

stock and $50,000,000 of 7% cumulative preferred stock. The shares are of $100 par value. The United States Smelting, Refining & Mining Co. has a capitalization of $75,000,000 in $50 shares; of this, $37,000,000 is in 7% cumulative preferred stock.

Should a company earn large profits there is a possibility that the common stock might receive a larger dividend than the preferred stock, since the preferred-stock dividend is limited to a specified amount. For this reason, a provision is sometimes made that after a dividend equal to that paid on the preferred stock has been paid on the common stock, all dividends above these requirements are shared equally by the two issues. If preferred stock is made cumulative as to assets it would prevent some outside interest from buying up the low-priced common stock and electing their own directors and then selling the property of the company. Unless cumulative as to assets, the preferred stock would have to share equally with the common stock, which might have little value because of poor dividend prospects.

Promoters and Promotion. The promoter of stock companies performs a necessary and useful function in the business world. Taken in the proper sense of the word, the promoter's field is to bring together capital and an enterprise in which capital can be usefully and profitably employed. He finds the opportunity and then turns it into a reality. So many fake schemes and unfortunate promotions have been inflicted on the public that the term 'promoter' is often regarded as one of reproach.

The work of the promoter may be divided into three stages: investigation, assembling, and financing. When a promising discovery has been made, the promoter must make a thorough investigation of the enterprise to test its possibilities. In large projects, engineers are employed to make a detailed survey of conditions and to draw up estimates of cost. No stone should be left unturned in the effort to view the project from all angles and to weigh carefully each disadvantage. Only in this way can correct judgment be passed on the enterprise. If the final judgment is favorable, the next step is to assemble the essential elements. This means securing all rights and options, chartering the new company, forming the financial plan, and preparing to sell the securities. All this takes time, and may require the spending of a large sum of money. Capitalists cannot be interested unless the project is in definite form. Then, for his own protection, the promoter must be secured in his title to rights and options. Instances have been known where the promoter had outlined his plan to a financier who had listened carefully but refused to supply funds, only to secure the options for himself as soon as the promoter had gone. The final step is the selling of the securities and getting the enterprise under way. To carry his work to a successful conclusion the promoter must understand his business thoroughly; he should possess tact and patience; he must have a good knowledge of men, as well as abundant energy and great perseverance. He runs large risks, and it is only fair that he be properly compensated. His continued success as a promoter depends upon his making money for his clients; for this reason he cannot engage in crooked work or be dishonest in his dealings. An honest promoter is always willing to supply any desired information to interested persons.

Although the mining promoter may interest himself in the claims of a prospector who needs money to develop his holding, most mining promotions are concerned with the sale of developed mines or the re-opening of abandoned properties because of improved market conditions or the discovery of a more suitable process for treating the ore. Owing to the element of speculation that is always involved in mining, the general public has suffered severely at the hands of unscrupulous mining promoters. Either because of ignorance or of failure to investigate, the most flashy advertisements and grossly exaggerated statements are believed, and hard-earned money is foolishly wasted. 'Blue-sky' laws in many States and the activities of the Federal postal authorities serve to curtail to some extent the operations of these fakers, but nothing short of educating prospective victims can put an end to their nefarious business. If the investor can determine the answer to the following six questions, he will have practically all the information he needs to pass intelligent judgment upon the merit of the proposition.

1. Is the promoter honest and in good standing among business men who know him?

2. Has the company a clear title to the property it is represented to own?

3. Has the property been developed so that the actual tonnage of ore and its mineral content are known, and have these figures been determined by a reputable engineer?

4. Has the proper treatment of the ore been worked out by a competent metallurgist?

5. Is the proposed capitalization ample to cover cost of property, the proposed plant, and, in addition, to supply adequate working capital?

6. Is the direction or management of the company in the hands of capable men?

An honest promoter is always willing to furnish trustworthy references. Information regarding men connected with the enterprise can be obtained from merchants, bankers, and editors of the technical press or of the mining department of newspapers. Many States maintain mining bureaus, which can supply valuable information to the investor. The technical press is often the source of useful information. Reports by reputable engineers on certain mining districts are available to those who are sincerely interested. The U. S. Geological Survey has published maps and reports on the mineral resources of many parts of the country. These reports can be obtained free of charge by addressing the Director, U. S. Geological Survey, Washington, D. C., or for a nominal sum from the Superintendent of Documents, Washington, D. C. If much money is to be invested it is advisable to employ a mining engineer to make an independent examination. Several prospective investors may club together to defray an expense of this kind. The true seeker for information will be able to learn much for, "The Lord helps them who help themselves".

Mining in the Ketchikan District

By JOSEPH ULMER

*The man who made the first mineral location in south-eastern Alaska was Charles Vincent Baranovich. He came to Alaska in the early 'sixties and married the daughter of Francois, cook for the garrison of Russian soldiers stationed at Fort Wrangell. His wife was born in the stockade, remnants of which are still visible. Baranovich engaged in trading with the natives, and in 1865 was granted a concession at Karta bay; his being one of the 21 concessions granted by the Russian government.

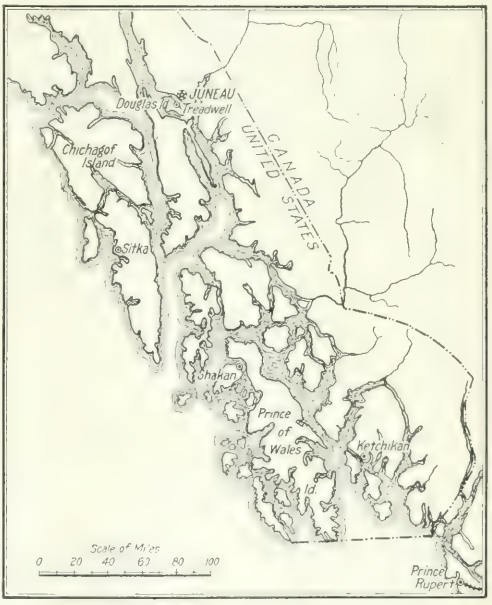
Baranovich established a trading-post at Karta bay, to which natives from Tolstoy, Wrangell, and even as far away at Sitka brought furs and skins. When the weather was stormy, the natives took their goods overland from Tolstoy bay to the entrance of the Salt Chuck, where they built signal-fires which brought Baranovich to meet them. On the point where so many of these signal-fires were made, the land is to this day devoid of all timber except second-growth and brush.

On one occasion, Baranovich planned to send the schooner 'Kasol' on a trading-voyage to Kodiak. Captain Kane, afterward for many years the pilot of United States revenue-cutters in Alaska, then a lad of nineteen, was the super-cargo of the 'Kasol'. The vessel was fitted out for this voyage at Victoria, B. C. While at Kodiak the crew, all Russians, mutinied and went ashore. After waiting three days in hopes that the mutineers would return, Kane went ashore to hire a new crew, and while he was gathering his recruits, the old crew went aboard the schooner at night, took possession, and sailed her to the westward, where they sold the cargo and bought five thousand seal-skins, which they sold for $1.50 each. Baranovich heard nothing of the 'Kasol' until he made his way to Kodiak, where he found the schooner abandoned, the mutineers having stripped her of everything, even the sails. The captain of the schooner was at Kodiak in a dying condition. Baranovich repaired and fitted up the 'Kasol' at Kodiak and then sailed her back to Karta bay.

In 1867, Baranovich located the Copper Queen mining claim, which was the first mineral location to be made in south-eastern Alaska, near the present site of New Kasaan. Years later, the claim was taken up by William Bunard, who is still living at Kasaan—a pioneer of nearly four score years and ten.

In 1900, U. S. Rush and George Brown, who had gone overland from the States to the upper Stikine River country, went down the river from Telegraph creek to Wrangell, where they got a rowboat and an outfit and started out on a prospecting trip on Prince of Wales island. They followed the shores of Kasaan bay into the Salt Chuck, where they found mineralized float, which they followed up and located the group of claims known as the Rush & Brown mine. These claims have been worked continuously since their location and have produced many thousand tons of copper ore. This mine is on two parallel shear-zones, and has chambers of magnetite carrying from 2 to 4% copper. The workings are now down to a depth of 400 ft., the ore maintaining its former width and value.

About the same year, Sam Lichenstadter, on his way



PART OF ALASKA

out from Dawson, met a Captain Crooks, who told Lichenstadter that while he was hunting in the Kasaan hills in the 'seventies he had found croppings of copper ore on the trip out from Dawson. Captain Crooks died, and Lichenstadter, who had come to Alaska as the representative of some London financiers, came to Ketchikan, where he got Ed Doolittle, F. F. Black, Harry Trimble, and Joe Johnson to go with him to Kasaan bay, where they made locations in behalf of their employer, naming the mine Mt. Andrews, in honor of Lichenstadter's backer. This was the real beginning of the mining era in the Ketchikan district. Work was started on the new discovery, and news of the resources of the district went broadcast.

*From 'The Pathfinder', of August 1920.

C. W. Fickert, who had come from Wrangell in 1899, and was hauling supplies to the Mt. Andrews in a sailing sloop called the 'Mamie', had prospected in the States, and decided to try his luck here, so he took a trip over the hills and, although he had been discouraged by the men working at the Mt. Andrews, he discovered the Mamie mine. Bob Allison, who had a half-interest in the sloop, was 'located in' as a half-owner of the Mamie, which half-interest he sold to James L. Freeburn, and Fickert sold his half-interest to Sam Silverman of New York. Chris Aus discovered the Stevenstown mine, which Silverman later acquired.

To operate the Mamie and Stevenstown the smelter at Hadley was built, and for several years Hadley was the most active mining centre in this part of Alaska.

The Mt. Andrews mine, which has produced a large tonnage of ore, was leased to R. W. Rogers, and is now held by an estate in London. The Mamie mine and Hadley smelter were purchased by the Granby Consolidated company, which shipped the ore to the smelter at Anyox, where it was used principally as a flux. Owing to the decline in the price of copper and the high cost of operation, the mine was shut down, although it produced sufficient ore to make it a profitable speculation.

The Goldstream group is a gold-producing property, located on the west arm of Tongass Narrows, Gravina island. The original claims, Goldstone, Goldstream, and Blue Bird, were discovered on December 15, 1902, and located on January 2, 1903, by Otto Miller and L. G. Phillips, and the Rose and Lilly on March 3, 1903. Charles D. Lane took the first bond on the property on October 13, 1903, and did considerable work. This property has been sold to several different parties, each working it for a time, and it is estimated by men who were in close touch with the operations that nearly $200,000 has been taken out. The mine is easily accessible, and if economy is applied, can be put on a paying basis.

The Jumbo and Copper Mountain properties produced a large tonnage up to 1919, but owing to the untimely death of Charles A. Sulzer, who was manager for the Alaska Industrial Company, the properties were closed, awaiting the settlement of the Sulzer estate. New York parties under the management of Captain Jones are now negotiating for re-opening these mines.

The Niblack copper mine, at Moira sound, has shipped about 400,000 tons of ore. The property is owned by the Wakefield estate. A. A. Wakefield, the pioneer mining engineer of this section, is at present doing preliminary work.

The Kasaan Gold Co. has purchased the Dunton gold mines from J. H. Rodgers of St. Louis, Missouri. This property, which is known locally as the Harris Creek mine, near Hollis, Prince of Wales island, was discovered by B. F. Redmond in 1908. Mr. Redmond, who is still living at Hollis, is 73 years old. The new company, under the management and supervision of M. M. Reese and Sidney Drake, installed a ball-mill, extra sets of plates, concentrating tables, and flotation plant, increasing the capacity to 100 tons per day. It has also a newly-built bunkhouse and messhouse. The mine connects with tidewater by a 3000-ft. surface tram. The shaft is down 410 ft., and drifts and laterals are driven along the vein to about 2000 ft. About 9000 tons of ore has been mined and milled, giving a recovery of $106,140. Approximately 100,000 tons of ore is blocked out.

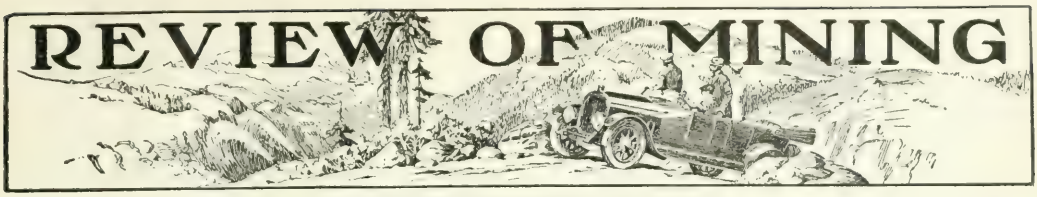
The It mine at Kasaan bay was discovered in 1906 by William E. Taylor. J. C. Barber and H. C. Strong of Ketchikan developed the mine and sold it to the Granby Consolidated in 1913, which extracted over one and a half million dollars worth of ore. It was mainly used as flux at the company's smelter at Anyox. The property was shut down about a year ago.

The Saltchuck mine, formerly the Goodro mine, was discovered by Young Walter Thomas on August 29, 1906, while out prospecting with Si Goodro. The first five claims were called the Joker group. The ore occurs in gabbro, cut by diabase dikes in no defined vein system, usually along fracture-zones. The principal ores are bornite and chalcopyrite, containing gold and palladium. The property is owned by the Saltchuck Mining Company. A 150-ton flotation plant, near the head of the Saltchuck, on Karta bay, is connected with the mine by a surface tram and a 1200-ft. adit.

There are a great number of undeveloped prospects in the Ketchikan mining district. None of the surrounding country has been thoroughly prospected. Mention is made here of Antone Denomie who won first place as the pioneer prospector of this section. He was sent by Major Baldwin, of Minnesota, to Valdez in 1898, then came to this district and discovered ore in the Karta Lake district. From Karta bay he went to the Portland Canal in 1906 and discovered the Indian mine on the Salmon river, thereby leading to the discovery of the famous Premier mine by William (Scotty) Dillsworth.

Ketchikan was the centre of mining activity 15 years ago, and bids fair in the near future again to be the hub for south-eastern Alaska. Ketchikan, the nearest distributing point for Hyder, at the head of Portland Canal, is the gateway to the great mineral belt extending from the head of Portland Canal to the north-west along the coast range, with its connecting avenues, the Unuk and Chickamin rivers. The Territorial Road Commission, the U. S. Bureau of Public Roads, and the U. S. Forest Service are co-operating to build trails and roads for prospectors.

THE first inspection of the shot that has misfired should be to determine whether or not the cause be outside of the drill-hole. It may be that the fuse has not burned to the mouth of the drill-hole, or that the legs of the electric device (electric detonator or electric igniter), or the leading-wire is short-circuited or open-circuited outside the drill-hole, or that the blasting-machine did not provide adequate current. If the cause lies outside of the drill-hole, it may be remedied without disturbing the charge. When a misfire has occurred in a hole containing an electric device, the blasting-machine should first be promptly disconnected and removed.



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

INSPIRATION SUES FOR REFUND OF TAXES.

GLOBE-MIAMI DISTRICT.—What is probably the biggest suit involving taxes ever instituted in the State of Arizona has been started by the Inspiration Con. Copper Co. and the International Smelter Co. for a refund of over one milion dollars paid in excess taxes in the years 1917, 1918, and 1919. The Inspiration's suit alone calls for a refund of $1,264,406, and the suit is filed in two different complaints calling for a refund of $694,224 for the year 1918, and $570,182 for the year 1919. The International Smelter Co. has petitioned in three different suits for about $165,000. In the petitions filed by their attorneys the companies claim that the State Tax Commission, sitting as a board of equalization, raised the valuations of their properties unconstitutionally, after the rate had been fixed by the county assessor and the Gila county board of supervisors, sitting as a county board of equalization. The Gibson Consolidated Copper Co. has temporarily closed down and it is reported operations will not be resumed until a better copper market develops. The management re-timbered the shaft and workings so that the property would not suffer during the enforced idleness. A pumpman is being retained to keep the workings from being flooded. At a meeting of the employees of the Arizona Commercial at Copper Hill, who went on strike last week, because of differences between the superintendent and the mine foreman, it was decided by a vote of ten to one to return to work immediately. Joseph Lord, Federal mediator connected with the Department of Labor, met with the men and was influential in bringing about an adjustment of the affair.

SUPERIOR DISTRICT.—The Magma Copper Co. has crosscut on the 1800-ft. level to the west and is reported to have found 11 ft. of ore averaging 13% copper. Crosscutting is still going on. The company has purchased seven claims to the west of the property, known as Magma Extension claims.

PHOENIX.—With the excavation work completed and eight carloads of material ready on the ground, the Arizona Gypsum Co. announced that operations on the construction of its $300,000 plant, six miles east of Phoenix, will be under way within the next few days. It is expected that the plant will be completed and operating in three months.

SUPERSTITION MOUNTAIN DISTRICT.—It is reported that a $25,000 mill is to be erected on East Pinto on a promising gold strike which was recently opened there. The property is reached by a wagon-road from the Goldfield side of Superstition mountains. The old Goldfield property, at the base of the Superstition mountains on the west side, is being revived. The property is controlled by George U. Young, secretary of Arizona during its last years as a Territory, and development is now under way. The property has been a large producer of gold in the past. The Silver King has been closed down on account of financial difficulties.

JEROME.—The tunnel at the Shea mine has penetrated the orebody that was opened on the 325-ft. level. The ore in the tunnel carries chalcopyrite which is replacing tetrahedrite and is over 6 ft. wide, assaying 0.40 oz. gold, 20 to 30 oz. silver, and 9% copper. The shaft and raise will be connected by the next round or two. It is reported that a rich strike of chalcopyrite ore has been made on the 1600-ft. level of the Jerome-Central mine. This property is one and a half miles south of Jerome.

GLOBE.—A 21-in. vein of full three-inch fibre-asbestos has been developed on the property of the Globe Asbestos Co., in the Chrysotile district. Seven tons of long-fibre asbestos has been shipped in the last few months and about 40 tons is blocked out. The mine is 64 miles from Globe, and transportation difficulties have caused serious consideration of some form of aerial transportation for the product of the three asbestos properties in the district. On September 1 the Van Dyke Copper Co. started the lateral development and exploration called for in its original program. Operations have been confined, until recently, to sinking the shaft, which has reached a depth of 1692 ft., and is the deepest in the Miami district. This great depth, compared with the shafts of the Inspiration and Miami companies, was necessitated by the fact that the eastern extension of the orebodies of the district has been faulted downward several hundred feet by the Miami fault. Shaft stations were cut at 1212 and 1550 ft. below the collar of the shaft, and the work is being carried on from these stations. Work on the 1212-ft. level is all in ore, in the orebody discovered by drilling and later penetrated by the shaft, where it was found to be 40 ft. in depth. On the 1550-ft. level a drift is being driven in the zone of mineralization.

TUCSON.—Facing the prospect of a shut-down of their enterprises, which they declare will result if the recent increase in freight-rates authorized by the Interstate Commerce Commission are put into effect, representatives of mining and smelting interests in southern Arizona and New Mexico met in conference last week with

representatives of the traffic departments of the railroads. Railroad traffic managers admitted the seriousness of the situation that confronts the mining men, but contended that the advanced cost in moving ores should not be blamed entirely upon the railroads. One railroad representative pointed out that cost of labor, material, and supplies for mines has advanced in many cases as much as 100% during a period that freight-rates have advanced only 50%. In the case of mines situated at points distant from railroads, he said, the cost of transporting the ore to the railroads has also advanced.

KINGMAN.—The shaft of the McCracken mine has now reached a depth of 600 ft. and has developed a large flow of water, which necessitates the immediate installation of pumping machinery. This water will prove of great benefit to the mine, as there has not been sufficient for milling-purposes and therefore the former operators erected their mill at Signal. J. C. Rankin announces that the shaft of the Payroll mine is to be re-timbered to the 200-ft. level, the timbering below that point being in good condition. The shaft is to be sunk to the 600-ft. level and the upper levels developed further. Most of the milling-machinery of the C. O. D. company's mill has arrived at Kingman. The shaft is now down 430 ft. and preparations are being made to mine the ore opened between the 300 and 400-ft. levels. The mill of the Kingman Consolidated Mining Co. at Stockton Hill is now operating. The machinery for the new power-plant at the tunnel-site has arrived.

NOGALES.—Two teams are steadily engaged in hauling high-grade lead-silver ore from the Tom Gardner and Lander Young lease at the Hardshell mine to Patagonia. The present rate of production is two carloads per week. It is said that there is 4 ft. of solid galena ore opened on the 325-ft. level. The Consolidated Southern Arizona Mining Co. is to unwater the old Mansfield properties, of which they are owners, with a view to the examination of the lower workings. The old shaft is down 360 ft. It is probable that the Richardson property recently optioned by the Consolidated will be developed from the old shaft [illegible] Mansfield.

[illegible]—The apex suit brought by the Tom Reed Gold Mines Co., involving the Big Jim vein, has been set for hearing before Judge Bollinger on October 4. The basis of the suit is the contention that the Big Jim vein apexes on the ground of the Tom Reed and that it has been faulted into United Eastern ground. The Tom Reed drift from the Aztec shaft on the 400-ft. level has been [illegible] extended 150 ft. toward the United American end-line. The United American has cut a station on the 170-ft. level, and cross-cutting on the 500-ft. level toward the [illegible] is expected the vein will be cut about October 15.

WILLCOX.—The Central Copper Co. now has over 100 men upon its payroll and is rapidly completing the new road across the Dos Cabezas mountains from the Mascot to the Lima orebody. There remains 3000 ft. of the 18,000 ft. of road to be completed. It is expected that operations will be commenced at the mine by October.

The Grand Reef mine, situated in the Aravaipa mining district 60 miles north of Willcox, owned by R. V. Dey of New York, is reported to have been purchased by the Aravaipa Leasing Co., which is controlled by the American Lead & Zinc Company.

COLORADO

RAILROADS WILL NOT INCREASE LOCAL FREIGHT-RATES.

CRIPPLE CREEK.—A five year lease on the Pharmacist mine, Bull Hill, has been given by the Pharmacist G. M. Co. to L. F. Le Brun and associates operating the South Burns mine of the Acacia G. M. Co., adjoining. Le Brun is drifting into the Pharmacist from the 1200-ft. level, of the Burns Enite. Cresson and Portland continue to be the largest shippers of the district.

LEADVILLE.—Railroad officials have announced that freight-rates to Colorado points will not be increased and that steps will be taken to nullify the interstate increase, but that the subject must be referred to the Interstate Commerce Commission before action is taken.

WELD COUNTY.—A potash deposit has been discovered and located in Hunter's Lake, 3½ miles west of Stoneham in this country by the Mentgen brothers of Sterling, and the Stoneham Potash Development Co. has been organized and incorporated for its development. Tests made by Louis D. Gentzler show from 50 to 68% potash in the crude material. The deposit covers more than 200 acres and the company has secured a long-time lease on 30,000 acres of land in proximity to the lake, which is known to contain coal.

CENTRAL CITY.—Gold ore assaying 13 oz. per ton has been discovered in Travellers gulch, near this city, by Peterson and Nearseter. The streak is reported to be 18 in. wide at the grass roots. Ore has been found in the Jack Rabbit tunnel in Twelve Mile. It contains $23 in gold, 30 oz. silver per ton, and some copper.

ALMA.—Ore assaying 160 oz. silver, 25% lead, and a little gold has been found in the Red Lion. The Dolly Varden, re-opened by the Louisiana-Colorado syndicate, with A. E. Moynahan former district mine inspector as superintendent, is the scene of a rich silver discovery. The ore assays from 400 to 600 oz. silver per ton. The May Queen is driving a tunnel from Buckskin gulch into Mt. Bross. A big body of milling-ore has been opened on the Hock Hocking on the Mosquito slope of Pennsylvania mountain. It is reported that operations will be resumed shortly in the Denver-Leadville tunnel on Mt. Loveland. The Hill Top mine is producing silver-lead ore steadily.

MICHIGAN

[illegible] ELECTRIC PUMPS IN CALUMET MINES.

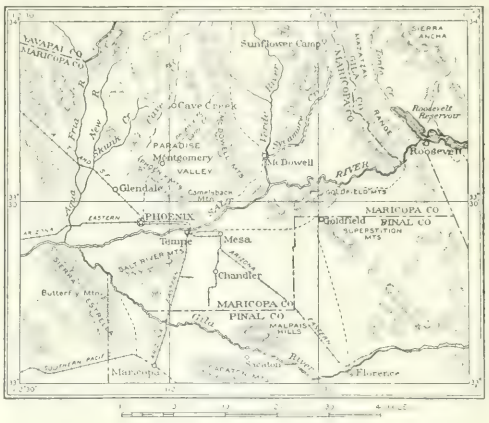
CALUMET.—Arcadian Consolidated's New Baltic shaft has a splendid showing at a depth of 600 ft. where the vein was penetrated by the cross-cut 15 ft. from the shaft. The vein is heavily mineralized, excepting one foot from the foot to the hanging wall and its width is 18 ft. The showing is considered the best ever opened in

the property, the ore being richer than that found on the 400 and 500 ft. levels. The 600-ft. level will not be developed at present and sinking will be continued to the 700-ft. level before explorations on the vein are resumed. The objective is the 900-ft. level, from which a drift will be started to connect with the New Arcadian shaft at a corresponding depth. There is evidence that the vein is approaching the shaft and in the event this proves to be the case no cross-cutting will be necessary. There is no faulting anywhere in the shaft and no difficulties are anticipated from such a source. As the 'rock' in the New Arcadian shaft is similar to that in the Baltic, and the ground in the latter has been proved to at least 600 ft., it is believed that the Arcadian has 3500 ft. of ground containing an unusually rich vein. The discoveries at New Baltic are considered the most important since the Baltic lode was developed, because the operations are far east of any producing mine. The shaft is more than a mile north of the old Arcadian shaft. It is proposed to continue development work through the winter if general conditions improve.

To keep as much water out of the mines as possible, numerous drainage-projects are under way in the north end of the district. Practically all of the water that is found in the mines comes from the surface and that which is found in the lower levels, even far below the level of Lake Superior, is negligible. The draining of the North Tamarack reservoir and the tract of swamp land west of the Hecla shafts by the Calumet & Hecla is a part of this plan. Allouez and Wolverine are draining old ponds also. As an indication of the size of the water problem, it may be mentioned that bailers of 2000 gal. capacity are operating in No. 5 Tamarack and Red Jacket shafts, in addition to the 1,000,000 gal. pumped every day. No. 5 Tamarack is used for bailing and until the haulage-tunnel is completed far enough to permit the placing of pumps in No. 12, it is impossible to resume mining in it. Because of the flow of water at No. 5, no mining has been done below the 40th level, but once the water is no longer troublesome the ground in that territory will be developed through sub-shafts. Wolverine also has had considerable trouble with water, but at present the flow is being taken care of. Within one year the company has been forced to spend nearly $15,000 to handle the accumulation of South Kearsarge water, for upward of 12,000,000 gal. had to be pumped to keep the lower levels dry. The flow of water is so great that operations cannot be carried on below the 38th level.

Mohawk maintains its daily tonnage of from 1700 to 2000 tons per day. The program of development now in effect will be followed until there is material improvement in conditions and there is a hope it will be broadened later to include the development of new ground.

Copper Range is carrying a slightly larger metal surplus than was reported 60 days ago and approximately 5,000,000 lb. of refined copper is on the docks and in process of refining. This compares with about 4,000,000 lb. at the end of last year. There is comparatively little change in operations at the three mines, Champion, Trimountain, and Baltic, and the underground forces have not increased during the past month. At the same time development work continues slightly above the rate for the corresponding period of 1919, and with the yield at about the same high figures—45 lb. per ton from Champion, 35 from Baltic, and 30 from Trimountain. During the past year, Copper Range has been adding re-grinding apparatus in connection with the effort to reduce the already small losses. About 40 tables have been added to the equipment of the Baltic and Champion mills. This will increase the recovery considerably, but it is by no means the final effort. There is a possibility that Copper Range will add flotation units to its re-grinding equipment just as soon as the cost of steel and other supplies return to somewhere near normal figures.



MAP OF CENTRAL ARIZONA

Seneca is cross-cutting the plat for the 5th level and by the middle of October it is expected that drifting will be started. The north drifts on the third and fourth levels are being pushed forward and the grade of the ore during the past week was satisfactory. The south drift on the fourth level is about 50 ft. from the Ahmeek boundary. Although recently the ore has been low-grade, it is not considered discouraging.

NEVADA

FLOTATION MILL AT GERLACH NEARLY COMPLETED.

Austin.—The Warner, in Washington canyon, 30 miles south of here, has been developed into an important mine by the sole owner, Mrs. Rose Warner, who has furnished all of the money for development. Mrs. Warner owns 21 claims. The vein, averaging 13 ft. wide, after being opened by several tunnels to a depth of 350 ft. on the dip, was cut recently in a 95-ft. shaft 600 ft. from the outcrop. The ore contains only a small proportion of gold, is free-milling, and is found as a replacement of limestone. The mine is 25 miles from Ledlie, on the Nevada Central, the nearest shipping point. Some of the drifts from the tunnels have opened rich ore. In a drift from tunnel No. 3 from 2 to 4 ft. of ore assaying $250 per ton is exposed. Other similar high-grade pockets have

been found, but the value of the mine is in the average-grade of the ore. Work has been started on another vein, 1500 ft. from the 95-ft., or New Hope, shaft, and ore assaying 500 oz. silver has been found near the surface. The mine has been developed for two years, the work being in charge of William M. Thacher, manager for Mrs. Warner.

Gold Park.—Most of the machinery for a 50-ton mill has been hauled to the Star of the West at Gold Park, in the south-western part of Lander county, and is being erected. It is expected to have the plant operating in two months. The Star of the West company, of which Robert B. Todd of Reno is president, is operating an old gold-silver-lead mine that has been re-opened. Amalgamation, concentration, and oil-flotation will be used in the mill. A new gold-find is reported 10 miles west of here, near Pilot, where an average of 84 samples taken from a 70-ft. shaft gave an average assay return of $79.20 in gold, according to persons interested in the new district. The formation is described as "a basic andesite, with the vein making in a shear-zone 200 ft. from a rhyolite contact". The claims on which the find was made are owned by Robert Burns and others, who started work in a 16-ft. shaft several months ago and continued it to a depth of 70 ft. A drift has been driven 65 ft. from the bottom of the shaft and in it there is an 18-in. vein of gold ore assaying $500 to $900 in gold and 50 to 100 oz. silver.

Gerlach.—A 50-ton flotation-plant has been practically completed by the Leadville Mines 40 miles north of here and it is expected the plant will be in operation before October 15, according to A. A. Codd of Reno, president and manager of the company. The Leadville has been treating silver-lead ore in a concentrator, which the flotation-plant will replace. The new plant will contain a Blake crusher, Marcy ball-mill, Dorr classifier, Colburn flotation-machine, and an Oliver filter. The main function of the filter will be to save water. The machinery will be driven by a 100-hp. engine.

Virginia City.—The miners have returned to work in all but the Gold Hill mines, receiving the $1 increase to $6 per day demanded. R. A. Hardy, manager for the United Comstock at Gold Hill, in a statement, declared that if the increase demanded were granted it would "wipe out any possibility of profit from the ore in sight and make the whole venture so precarious and unattractive that it could not be continued at the present time". He said the only solution appeared to be "some system of group contracts under which the men would receive compensation in proportion to their efforts". The 'bonanza' winze from the 2150-ft. level of the Consolidated Virginia has been sunk 40 ft. and during last week there was produced from it 88 tons of ore assaying $86. Some of the ore from this winze has assayed more than $1000 per ton in mine carloads lots.

National.—A shipment of 18,634 lb. of ore from the Bell-Prour lease on the Buckskin National gave a smelter return of $134 in gold and $252 in silver per ton. The ore was mined from a 6-ft. vein containing the thin seams of almost solid metal for which the district is noted. The lessees cut the vein at a depth of 350 ft. by driving an 800-ft. tunnel and a winze is being sunk in the ore.

Goldfield.—The Silver Pick is raising from a depth of 110 ft. in the leased Red Top mine of the Development and indications are that shipments will be started to the Development mill within 20 days, according to Mat Murphy, superintendent for the Silver Pick. Miners that worked for the Consolidated in 1913 reported that there was ore in a stope extending to the surface when they were driven from it by caving ground and these statements were verified recently when Murphy entered the caved area by climbing down the stope from the surface. A 90-ft. drift was driven in the foot-wall of the vein near the caved ground and it broke into an old drift which is impassable near the Red Top shaft. The walls of the old drift were found to be standing well near the stope, but it was half filled with sand washed in by a storm. Tracks were laid on the sand, the roof of the drift was shot away and a raise that should enter the stope in 40 ft. has been started. When he entered the stope from the surface Murphy sampled two 5-ft. widths which gave assay returns of $22 and $111 respectively. He says the hanging wall of the stope is in good condition and that there will be no trouble in exploring it. George Meuli, a lessee on the Lone Star, has abandoned his plan to build a mill on Lone Star ground and has secured a site in the southern part of the town of Goldfield. He has ordered a Gibson mill which will treat 10 to 12 tons of ore daily.

NEW MEXICO

MINING COMPANIES PAY MOST OF THE TAXES IN GRANT COUNTY.

Pinos Altos.—Considerable development work is being done on the Bald Back mine, situated a mile from the famous Silver Cell mine in the Pinos Altos district.

Silver City.—The New Mexico Mining Association was organized on September 9 and is preparing to make formal application to the American Mining Congress for a charter which will permit the temporary organization to become the New Mexico Chapter of the American Mining Congress. John M. Sully is chairman of the executive committee.

Of the $35,476,000 assessed valuation in Grant county, 61.3%, or $21,733,551, represents property of three only of the mining companies. The remaining 38.7% is made up of all other property in the county, including livestock, farms, city property, personal property, railroads, banks, and the smaller mines. The three companies referred to are the Chino, assessed at $18,333,946, including real and personal property and net output; the Phelps Dodge Corporation (Burro Mountain branch), assessed at $2,973,545; and the Empire Zinc Co., assessed at $436,042. A similar condition is reported to exist in McKinley county. There the taxes on $7,700,000 of the assessed valuation of $11,000,000 are paid by 12 leading companies, including some mercantile establishments and the railroads, leaving to all the rest of the county the payment of taxes on only a little more than $3,000,000.

UTAH

TINTIC STANDARD PASSES DIVIDEND.

FRISCO.—John Amsden and Wm. Webb have secured a contract from the Consolidated Nevada-Utah Corporation for a considerable amount of development work on the company's property near here known as the Imperial group.

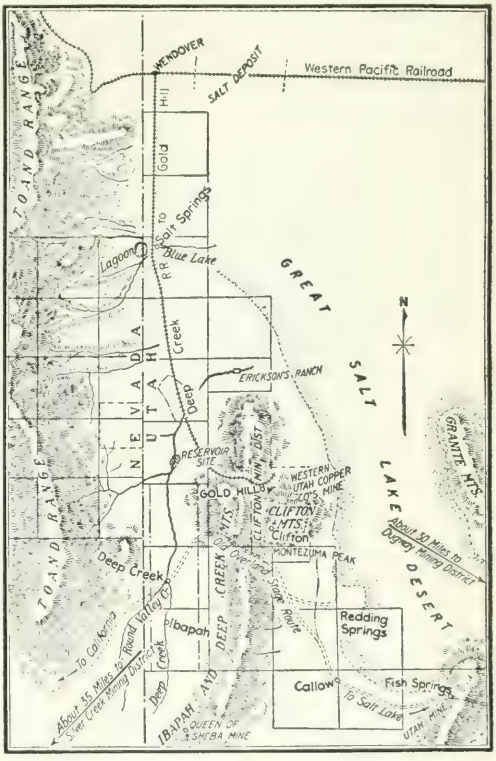
AMERICAN FORK.—Geo. E. Hemphill, manager for the American Consolidated Mines Co., in American Fork canyon, reports that the company is shipping a high-grade silver-lead product, averaging from 40 to 50% lead and 15 oz. in silver. The vein from which the product is being mined is about 2 ft. wide.

ALTA.—R. O. Dobbs, general manager for the Louise Mining Co., reports that an important discovery has been made in the drift west of the second raise in the Maggie adit. The new find is a high-grade copper-silver-lead carbonate, only about 15 ft. below the contact, where a larger orebody should be developed. About 40 ft. of drifting remains before reaching one of the objectives, where development above has shown conditions indicating an orebody at the intersection of the cross-fissure with the main body. A contract has been let for hauling the ore to the railway a mile away.

BIG COTTONWOOD CANYON.—The Cardiff Mining Co. is shipping approximately 65 tons of ore per day, according to Lynn Thompson, engineer for the company. The ore is coming from the 800-ft. level. Pumps were started recently to unwater the mine below this level and it is expected that shipments will be made soon from the deeper workings. The ore averages about $60 per ton. Thos. Prichard, in charge of operations at the Big Cottonwood Bonanza property, reports the cutting of the Bonanza fissure, one of the present objectives. The fissure was cut by a drift 275 ft. long. The vein-matter is principally manganese and iron, with large seams of spar. The footwall is quartzite and the hanging wall limestone. The Bonanza fissure runs northeast-southwest, and it is stated that the contact is similar to that in which the Cardiff found its main orebodies. Small seams of iron carbonate from the intersecting cross-fissure are beginning to appear, which is taken as an indication that the intersection should be reached soon.

C. R. Green, president and manager of the Victor Mining Co., states that driving west on a fissure found 1600 ft. in the Victor tunnel, has been started. Sufficient surface work has been done on the contact to demonstrate the desirability of undertaking development in depth. This is reported to be the same contact in which the Cardiff mine developed its large orebodies. From 150 to 200 ft. of work will be required to reach the objective. It is stated that the American Consolidated Copper Co., which owns the ground immediately west of the Victor, is negotiating for a right-of-way through the Victor tunnel.

PARK CITY.—Operations have been resumed at the property of the Three Kings Consolidated Mining Co. The company has recently erected a new blacksmith and carpenter shop. For several years exploration work has been carried on at this property, and the diamond-drilling established the fact that the ore-bearing limestone so productive in the Silver King Coalition property, extends into the Three Kings formation through the Kentucky claim. The cross-cut tunnel driven on the 700-ft. level has cut seven ore-bearing fissures, traversing the formation in a northeast-southwest direction. Ore was found in fissures 1, 2, and 4. In a winze and raise in fissure No. 4 samples assayed as high as 100 oz. silver and 69% lead, while the average for the entire exposure was 28 oz. silver and 30% lead. J. R. Elliott, of Pittsburgh, who



WESTERN BORDER OF THE GREAT SALT LAKE DESERT

represents the Eastern interests in the company, is expected at the property shortly.

Five mines in this district shipped a total of 1747 tons during the week ending September 18, of which amount the Silver King Coalition shipped 618; the Judge M. & S. Co., 391; the Ontario, 392; Daly-West, 226; and the Naildriver, 120.

James B. Allen, manager of the Glenallen property, reports that sufficient funds have been secured by the company to build a mill for treating the low-grade ores. An assessment was recently levied by the company, but as outside capital has been obtained, the assessment has been cancelled. Preparations are under way for resumption of work at the property of the New Quincy Mining Co.

Coal and supplies are being hauled to the mine, and the hoist at the Little Bell, through which the New Quincy will be developed, has been put into operation.

EUREKA.—Several months ago, L. E. Riter and associates of Salt Lake City, secured a lease on a large block of ground in the Eureka Hill mine, and then made arrangements to handle the work through the Centennial-Eureka company's 900-ft. level. A drift 181 ft. long was driven by the lessees when they found a high-grade silver-lead orebody. The drift is following the ore on its strike and at present is in ore assaying 40% lead and several hundred ounces silver per ton. Charles Baker, superintendent, reports that there is a large area of virgin ground near this new strike, and he believes future development will disclose orebodies of considerable value. For several years not much development work has been undertaken at the Eureka Hill, although at times sensationally rich ore has been struck in the property. At the North Beck property, controlled by E. J. Raddatz and associates, work is now confined to the 1600-ft. level. This is the deepest point reached from the new working-shaft, and a drift is being driven toward a break which, on the level above, carried ore and it is believed that this shoot extends to the 1600-ft. level. The North Beck people are also working the adjoining claims of the Victoria Gold Mining Co. After sinking the shaft at this property to the 600-ft. level, drifting was commenced. Bunches and streaks of good ore have been continuous for a distance of more than 150 ft. on the 1840-ft. level of the Eureka-Lilly mine, according to Grant H. Snyder, manager. This drift is being driven toward the south to open up a shoot struck on the 1640-ft. level; this shoot being over 250 ft. long on the latter level. Inasmuch as the stringers on the 1840-ft. level are appearing at a considerable distance from the objective, officials believe that the Tintic Standard ore channel will be found.

During the week ending September 18, the Chief Consolidated shipped 41 cars of ore; Tintic Standard, 28; Mammoth, 20; Dragon, 14; Eagle & Blue Bell, 8; Iron Blossom, 7; Iron King, 6; Gemini, 4; Swansea, 4; Gold Chain, 3; Grand Central, 3; Bullion-Beck, 3; Victoria, 3; Centennial Eureka, 1; Ridge & Valley, 1; Griggs Huish, 1, making a total of 147 carloads, as compared with 142 for the previous week.

By a unanimous vote, the board of directors of the Tintic Standard Mining Co. passed the quarterly dividend at their meeting in Salt Lake City on September 20. W. I. Snyder, vice-president of the company, issued a statement to the stockholders, stating that the principal reason for passing the dividend was the large expenditures made recently in connection with the construction of the mill and railroad; the two items aggregating $360,000. During the first eight months of the current year, the net earnings of the company totalled $624,062. Two dividends, aggregating $234,040, have been paid out of current earnings, during that period. Labor during the past few months has been scarce, and the mine has been running with less than 60% of the men that could be employed to advantage. E. J. Raddatz, president, says that never in the history of the mine has there been a greater quantity of first-class ore in sight than at the present time, and after the crops are harvested and state-road work reduced, it is believed additional labor will be available for the mines in this district.

WISCONSIN

NEW DEVELOPMENTS NEAR CUBA CITY.

LIVINGSTON.—The Fearless Mining Co., Sam Altenberg, superintendent, has acquired the Squirrel mine formerly under the management of the B. M. & B. Mining Co. The mine has been further developed, the surface rig overhauled and put into service, and shipments of zinc ore are now being made. J. B. Piquette, president of the Fearless Mining Co., has secured the support of Chicago capitalists, and has taken over the Nightingale mine, south-east of Benton. The prospect has been thoroughly proved with drills and invites investment to make it a producer of both zinc and lead ore. A two-compartment shaft will be sunk at once but mill construction will not be begun until the extent of the orebody is determined.

CUBA CITY.—At a meeting of the stockholders of the Connecting Link Mining Co. held under special call at Cuba City, September 15, an amendment was voted to the charter increasing the capital stock from $100,000 to $300,000. A new mill has just been put into commission on shaft No. 1, the second of this style and type to be installed. Extensive exploration work on new leaseholds recently acquired and further development and equipment are the reasons for increasing the capital stock. The Connecting Link produces both lead ore and zinc ore.

The Zinc Hill Mining Co. is following an active program in this district. A two-compartment capacity shaft is going down on the Susan Dean farm, to tap a lode of zinc ore proved by drilling, and mill work is under way. Drills on the Wm. Mueller farm are in the 57th boring. It is proposed to carry this work of exploration up to about 100 borings. The Mueller land shows extensive deposits of lead ore in the blue rock strata a feature uncommon in this field. It is claimed by those in charge of the work that one of the best lead mines known in the field will be developed as a consequence of these discoveries. Shipment of zinc ore is being made by the Zinc Hill Mining Co., from the Big Dick mine, at the rate of 3 to 5 cars per week. Lead ore is mined in quantity and new ground for lead-ore production is being opened up on the range north-west of the Big Dick mill.

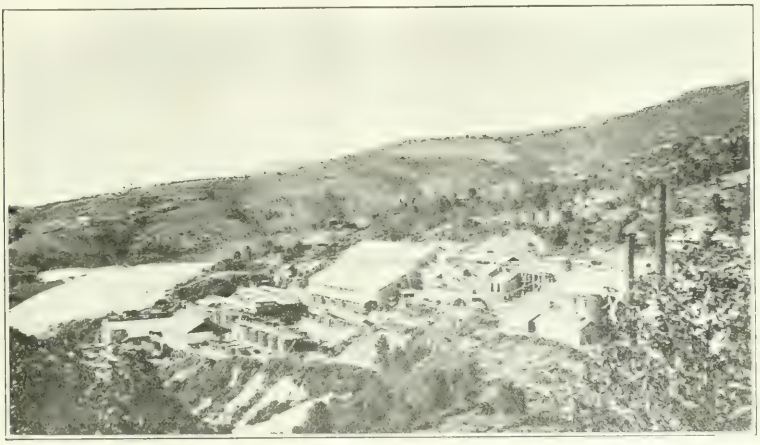
BRITISH COLUMBIA

INCREASED FREIGHT RATES INJURING CANADIAN MINING INDUSTRY.

VANCOUVER.—The Canadian Railway Commission has granted an increase of 35% in the railway freight-rates in British Columbia, and the change already has gone into effect. This will work great hardship to a number of mining properties, and in many instances will mean

that the ores must be concentrated before shipping to the smelter or the properties will have to close. It is not so harmful to the mines situated on the coast, because they probably will ship to the Tacoma smelter, and, having the advantage of water transportation for the whole distance, will not be affected seriously. The Granby Consolidated M. S. & P. Co., which has heretofore shipped its blister-copper by the Canadian Northern, has made arrangements with the Canadian Dollar Shipping Co. to ship its blister by the Panama Canal.

Accounts concerning the Mayo district, the new silver camp near Dawson, are being received from miners and prospectors who are coming south for the winter. They say that Mayo City, 150 miles south-east of Dawson, on the Stewart river, bids fair to become a 'city of tents' because of the rush to that point of miners intent on



LAS DOS ESTRELLAS, EL ORO, MEXICO

making locations. The Guggenheim interests have taken in large quantities of supplies and are engaged in operations on Keno hill. They plan to take out 3000 tons of ore this winter. On Lookout mountain the Yukon Silver-Lead Co. is down 450 ft. on the vein with a large body of concentrating-ore in sight.

STEWART.—That the Salmon River section of the Portland Canal mining division in northern British Columbia has gone through its boom stage and there is now in progress much development that promises good results is the opinion credited to S. J. Schofield, who has returned after spending a summer at the head of a geological survey party in that region. The results of Dr. Schofield's researches will be published by the Canadian Department of Mines in the course of a few months. The Premier mine was the only property being worked at the time of Dr. Schofield's departure and on it a mill was being constructed to handle the low-grade ore. Shipments will be made during the winter; about 150 men are employed. The New Alaska property will be developed this winter. The group is situated in the Portland Canal district and the showing is good. A small gang of men has been working recently on the property of the Fish Creek Mining Co., situated on the Alaska side of the boundary; a 4-ft. vein of galena has been uncovered. Work on the Silver Tip, Salmon River, has been closed down for the winter. The owners have had a considerable force engaged in stripping and preliminary surface operations; stringers of high-grade silver ore have been uncovered and it is planned to continue development next year.

James McKay and Charles Bibean have extended the option on their Lakeview property, at Glacier creek. Pat Welsh and associates, the optionees, have done a considerable amount of surface-stripping during the summer, and they felt that, although the result did not warrant them in taking up the option, it did warrant further exploration. Fitzgerald brothers have made arrangements for the exploration of their property on the Alaskan side of the boundary with a diamond-drill.

TRAIL.—While drilling to what he believed would be a deposit of salt, J. A. Allen, of the University of Alberta, recently discovered a stratum of gypsum at a depth of 510 ft. The layer appeared to be of sufficient value to make commercial use practical.

PRINCE RUPERT.—While passing through this place a few days ago, H. S. Munroe, general manager for the Granby Consolidated Mining & Smelting Co., made the statement that the company is shipping 15 cars of copper per week. The output of Anyox will be increased, it was asserted, as soon as the price of the metal is high enough to make it profitable. The present low price has resulted in a policy of producing just sufficient to keep the plant in operation, the production being about 2,500,000 lb. per month. With better market conditions this could be increased without difficulty to 3,500,000 lb. per month. Referring to the Granby company's property, the Midas near Valdez Peninsula, Alaska, Mr. Munroe said that production would be commenced as soon as there was a stronger demand for the metal. The ore is

high-grade but will be concentrated before being shipped to the Tacoma smelter. He was reticent regarding the company's mining policy in the Boundary district, leaving the impression that not much could be expected while the copper market remained weak.

KASLO.—Working on No. 1 level of the Washington mine, near the Rambler-Cariboo, lessees recently shipped a carload of galena ore that they had taken out in three weeks. It averaged more than 150 oz. of silver per ton and 65% lead. At the same time lessees on the No. 3 level of the Rambler-Cariboo are said to be working in rich ore. A part of the Whitewater mine also is being worked under lease and it is authentically reported that the operators have shipped two carloads of ore from a newly uncovered orebody which has brought large returns. This work is near the Wellington mine, where No. 2 tunnel-level is being re-opened by the Standard Silver-Lead Mining Co. Labor conditions are improving in this district. The Payne mine, one of the first locations in the Slocan, is under bond and lease to a Seattle mining syndicate. A long lower cross-tunnel opens the property to a depth of 1500 ft., but little exploration of the vein at that level has been attempted. Above the fifth level the mine has been largely worked out, but below there is a large area that is expected to contain ore.

HOPE.—The re-opening of the Emancipation mine, near Hope, is assured. Equipment to the value of $20,000 has been installed and it is expected that the first shipment of ore will be made next month. E. T. Hodge, the manager, states that the ore is high-grade, running as high as $303 per ton. The vein is from 5 to 25 ft. wide and proved over the length of two claims.

ONTARIO

NEW DISCOVERIES AT THE PORCUPINE CROWN.

COBALT.—One of the most interesting pieces of exploration work ever undertaken in the Cobalt district, is now under way at the Crown Reserve mine. A diamond-drill hole is being put down 2000 ft. for the purpose of learning whether there is another diabase sill at that depth. One large diabase sill which passes through and over the Cobalt mines is believed by geologists to have been the source of the silver-bearing solutions which passed into the crevices and fractures of the adjoining conglomerates and Keewatin formation, creating the veins of silver ore. The veins have usually been found to extend not more than 1000 ft. from the diabase sill, and for that reason the deposits of silver ore are confined within definite limits. While excavating for the foundation of a rock-crusher at the old dump on the Kerr Lake mine, a narrow vein has been found, measuring less than one inch wide and consisting of calcite containing smaltite and silver. The vein is believed to be the one which was previously cut on the 90-ft. level, but which contained no silver at that depth. It lies beneath eight feet of sand overburden and will be opened from the surface. A silver discovery has been made in the Gillies Limit on the Cobalt-53 property, at a depth of 60 ft. In the narrow part of the vein there is high-grade silver ore and the prospects are encouraging. Mining operations have been suspended on the White Reserve mine at Maple Mountain in the Elk Lake district, but exploration work will be done by diamond-drilling. A deal is being negotiated with English interests. A small steam-driven mining-plant has been erected on the Silver Bullion property at Leroy Lake, and sinking will be continued in an inclined shaft formerly put down 60 feet.

The Kerr Lake Mines, Ltd., has declared a dividend of 12½c. per share, payable October 15 to shareholders of record October 1. The disbursement will amount to $90,000 and is the first to be made since the company made a capital reduction of $1 per share on September 13 last year. Total dividends paid by this company now amount to $9,780,000 since October 4, 1905.

PORCUPINE.—Labor conditions are beginning to show some improvement with the advance of the season. The men who went west as harvesters are gradually returning, and dullness of trade in some of the manufacturing centres of the United States has resulted in an influx of laborers from that quarter. There is still a shortage of about 2000 and production is thereby limited. The main shaft of the Hollinger Consolidated is being put down to the 2000-ft. level, and has now reached a depth of between 1600 and 1700 ft. The annual report of the McIntyre for the year ended June 30 shows a net profit of $818,020, as compared with $683,350 for the previous year. Operating-cost increased from $825,998 to $900,495. The quantity of ore treated was 188,835 tons of an average value of $11.52 per ton, showing a considerable improvement over last year when the average value per ton was $9.76. The total recovery of bullion was 99,461 oz. of gold and 21,140 oz. silver, valued at $2,080,178, or $11.02 per ton treated. The ore-reserves were estimated at 502,682 tons valued at $5,595,500, as against 433,057 tons valued at $4,777,324 last year. The exploration program of the North Crown on its Porcupine Crown property has resulted in a discovery which may be important to the entire Porcupine field. The diamond-drill has reached a depth of 2300 ft. and three other 1000-ft. holes will be put down. It is found that the greenstone formation tends to increase in extent, and indications point to the probability that much of the porphyry area found on the surface is underlaid with greenstone. The existence of this formation in proximity to the porphyry is specially favorable for gold deposits. Cross-cutting from the workings of the Porcupine Crown toward the Thompson-Krist property is actively progressing.

KIRKLAND LAKE.—The Orr, formerly the Kirkland Porphyry, has cut, on the 400-ft. level, what is thought to be the continuation of the Lake Shore No. 1 vein. It is 5 ft. wide and well mineralized. David Elliott has begun an action against the Orr Gold Mines, Ltd., and Hamilton B. Wills to set aside the issue of 800,000 shares of the company stock to Mr. Wills as a consideration for the transfer of certain mining shares, and to restrain Wills from dealing in the stock. The Lake Shore has begun sinking its shaft from 400 ft. to the 800-ft. level and will probably complete it by the end of the year.

THE INCREASE IN FREIGHT RATES

Salt Lake City.—More than a score of metal-mine operators from Nevada, Idaho, and California met with representatives of western railways in this city on September 22 and 23 to discuss freight rates. A. S. Edmunds, freight traffic-manager of the Salt Lake Route, presided at the meetings. The concensus of opinion among the mining men present was that unless some relief was granted from present high operating-costs, many low-grade properties in the West will be compelled to suspend operations. Utah mine operators were not active at the conference, as the State public utilities commission refused to permit the railways operating in Utah to increase freight charges on coal and ore shipments. A number of the mine operators present at the meeting submitted figures showing the effect of the increase of 25% in freight rates on their operating costs. Development of mines in Plumas county, California, will be greatly curtailed unless relief is granted was the assertion of representatives of various mines in that district. E. E. Paxton, of the Engels Copper Co., stated that his property is in the development stage and that $2,500,000 had been expended to date on the mine. He furnished figures to the conference, showing the increases on mine supplies, such as steel, powder, flotation-oil, etc., which have resulted since the freight rate increase on August 26. Mr. Paxton further stated that the crude ore at the Engels property averages from 2.25 to 2.50% copper, with some silver; that a ten years' supply of ore is blocked out in the mine, with a much larger prospective supply. The Engels property is connected with the Western Pacific Railway by a railway 28 miles long, four-fifths of which is owned by the mining company and the remainder by the Western Pacific company. Mr. Paxton concluded his arguments with the statement that since the freight-rate increases on supplies and concentrates, operation of the property was a losing venture. A representative of the Franklin Mining Co., in the same district, stated that more than 20 mines in the development stage would be compelled to close unless relief is granted that will lower their operating costs. Officials of the Ward Leasing Co., near Ely, Nevada, stated that they have 200,000 tons of low-grade ore developed, averaging about 7% lead, 2 to 3 oz. silver, with an excess of iron; that a favorable smelting contract had been offered them, but that they would be unable to continue operations under present freight rates. Morton Webber, representing the Empire copper mine at Mackay, Idaho, stated that his company had a deficit since the first of the year of over $40,000; that more than $20,000 per year is paid by the company in freight charges, and that if the recent raise had been effective since January 1, the deficit would have been more than $8000 additional.

Carson, Nevada.—The Nevada public service commission has denied the application of the railroads for a blanket increase in freight and passenger rates, a decision that is gratifying to the mining interests of the State. The decision declares the present rates to be 'discriminatory' and arraigns the railroads for the use of too-heavy equipment and consequent "failure to take advantage of economic methods of operation". The commission considered that "except as to coal, oil, and ore shipment, the reasonable, economical, all-the-year-round needs of traffic are best served by the use of cars not in excess of 30 tons capacity". The mining interests were represented at the hearing by John G. Kirchen, S. Herbert Williams, and George R. Ryan.

Pioche, Nevada.—The San Pedro, Los Angeles & Salt Lake railroad will not advance the rate on ore valued at less than $7.50 per ton and will haul ore of this grade from Pioche to Salt Lake City at the old rate of $2.25 per ton. From 12,000 to 15,000 tons of ore is shipped monthly from the Pioche mines and the average profit is about 50c. per ton, which would have been wiped out had the railroad increased the rate.

CALIFORNIA

Amador County.—Webb Smith who has been superintendent of the Kennedy mine for 17 years is leaving. He will be succeeded by James Spear.

Engelmine.—The Engels Copper Mining Co. has commenced work for an impounding-basin on the land formerly known as the Stark ranch. A flume more than three miles long will be built to deliver the tailing to the basin.

Grass Valley.—The Idaho-Maryland is adding an electrically driven pump to its equipment in the Canyon shaft. It is portable and has a capacity of 350 gal. per minute. The Delhi Mining Co. is erecting a plant to use the available water-power. The bulk of the power generated will be sold to the P. G. & E. Co. George W. Root was elected president of the Alcalde Gold Mines Co.

Porterville.—The Porterville Magnesite Co. has announced that it will resume operations at full capacity.

San Francisco.—J. H. Massen is arranging to begin shipping fluorspar by motor-truck from his claims at Afton.

Sierra County.—Coarse gold with pieces worth a dollar or more is being recovered at the Table Rock mine. Twenty men are employed. The gold is in a layer of pipe-clay and its recovery is difficult. Sinking the 200-ft. shaft at the Kate Hardy is being continued in spite of the shortage of power although the mill is hung up on that account. The tailing at the Young America mine has been sold by J. Bonnalli. Richard Phelan has bonded the Buttes Saddle and Sacred Mount quartz mines on the Sierra Buttes.

IDAHO

A flat increase of 60 to 75c. per ton in smelting charges on all ore received at the Bunker Hill smelter was announced by F. M. Smith, director of the Spokane office of the company. The increase will take effect at once. The action was taken following a general raise all over the country. "The increase in the cost of coke, coal, and all general supplies, because of the increase in freight-rates, is the reason for the raise," said Mr. Smith. "The exact amount which we will be compelled to assess the miners has not been determined, but it has been decided to make it a blanket increase on all ores. As near as I can state from observations the increase will be from 60 to 75c. per ton." Operations at the North Bunker Hill property in Wardner are progressing in a very satisfactory manner, according to reports. A cross-cut is now under way from the 500-ft. level of the main shaft, which is to be extended westward some 200 ft. to cut the vein exposed on the 500-ft. level. Good progress is being made with the work.

TEXAS

O'Donnell.—Although practically all the briny lakes and basins of this part of Texas have been under lease for potash development for more than a year nothing has been done yet toward actual production of potash. It is asserted that one reason for the delay in constructing potash-extracting plants is the fear that importation of the German product may be resumed and it would then be unprofitable to work the domestic deposits.

According to the reports of chemists who have tested the water and earth material of the different deposits of the south plains region of Texas they contain potash in great abundance and the average content is more than 12%.

The tentative plans of the lessee call for the construction of large plants at O'Donnell, Meadow, and Brownfield. It is said to be feasible to pipe the potash-laden water from the lakes to these railroad points.

MEXICO

Under date of September 13, a presidential decree was issued at Mexico City, extending to November 1, 1920, the time in which back taxes might be paid on mining claims which had fallen in arrears. This carries with it the proviso that taxes levied on the properties for the year 1920 shall be paid also on or before that date. What is said to be one of the most important mining deals in recent months was concluded in El Paso last week, when a local syndicate, composed of George A. Croff, Frank M. Pukli, R. H. Manning, and associates, took over the Bernice mine at Comidor, Chihuahua, having leased and bonded the property for a term of 25 years. The mine is in the Ventana mountains, an offshoot of the Pilares, just across the Rio Grande from Presidio, Texas, and some 30 miles south of Valentine. The ore is in veins and deposits in limestone and carries lead and silver. One vein over 4 ft. wide outcrops boldly for over 900 metres along the top of the mountain. The ore is said to run 75% lead and carries a few ounces of silver, and according to assays will net, after paying hauling and freight expenses, between $95 and $100 per ton. The lessees are planning to begin operations at once and will drive a crosscut 100-ft. adit from the eastern side of the hill that will cut the vein at a depth of 100 ft. The ore will be hauled to Valentine or to Chispa, on the G. H. & S. A. railroad for shipment to the El Paso smelter. Another important mining deal is reported to be under way farther dawn the Rio Grande on the Boca del Carmen property, a big lead-silver property on the Mexican side of the Rio Grande, 90 miles south of Marathon, Texas. In the Las Minas mountains east of the station of Ojo Caliente, a mine of silver-lead is being developed by a company of El Pasoans. The ore is said to be high-grade silver and lead. Conditions in Chihuahua are considered as good or better than at any time since the death of Madero.

Because of the clearer political atmosphere Greene-Cananea resumed dividends last month, paying 50c. per share. The mine strike at Cananea, Sonora, has been called off, according to a report made to Gov. Flavio A. Borquez at Nogales, Sonora, by a commission appointed by President de la Huerta to investigate threatened labor troubles in the Cananea district. The commissioners reported to Governor Borquez that the miners demanded more pay for less work. Their recommendation to President de la Huerta will be a compromise. The Moctezuma Copper Co. is making great improvements in its plants at Nacozari and Pilares, Sonora. It has recently completed an addition to its power-house at Nacozari that will house four new Diesel engines. The concentrating-mill is being remodeled so as to get improved costs and increased efficiency. The capacity of the mill will be increased from 2000 tons to 3000 tons. At Pilares, new blacksmith, tool-sharpening, and machine shops are being erected, as well as foundations and a building for new air-compressors.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

C. B. Lakenan is in San Francisco.

Morton Webber is at Salt Lake City.

Arthur DeW. Foote, of Grass Valley, is here.

J. W. Paul, of the U. S. Bureau of Mines, is in Utah.

Henry Krumb has returned to Salt Lake City from New York.

L. S. Cates has returned to Salt Lake City from Arizona and New Mexico.

W. O. Pray has moved from Des Moines, Iowa, to De Beque, Colorado.

H. B. Tooker, traffic manager for the Jackling companies, is at Salt Lake City.

Simon R. Guggenheim was at Pocatello, and is visiting several mines in Idaho.

A. J. Beaudette, of Seattle, is visiting San Francisco, on his way to South America.

Norman Carmichael, general manager for the Arizona Copper Co., is in New York.

Rudolf Gahl, of New York, is now with the Cerro de Pasco Copper Corporation, in Peru.

H. C. Carlisle, of the Nevada Wonder Co., at Tonopah, was in San Francisco last week.

D. M. Pattison, of Los Angeles, formerly manager of the Denn mine, is at Bisbee, Arizona.

A. W. Hahn, metallurgical engineer for the Metals Disintegrating Co. of New York, is in Utah.

T. M. Daulton, general manager for the Placer Gold Mines Co., of Atlin, British Columbia, is at Seattle.

W. A. Green has left Palo Alto to go to La Paz, Bolivia, where he will be with the Guggenheim Brothers.

Horace V. Winchell, on his return from Alaska, passed through San Francisco on his way to Oatman, Arizona.

Kirby Thomas, of New York, will be in Colorado several weeks engaged on examination work in the San Juan district.

Alliene Case has resigned as general superintendent of the Tonopah Extension mine, and is now living at Oakland, California.

Robert R. Pollok was in San Francisco on his way from Webb, Arizona, where he has been making an examination of vanadium deposits.

Charles R. Fettke, mining geologist with the Carnegie Institute of Technology, has been visiting mining and metallurgical centres in Utah.

E. M. Sawyer, manager of the Burro Mountain branch of the Phelps Dodge Corporation, at Tyrone, New Mexico, is spending a few weeks in California.

B. B. Nieding, formerly manager for the Carbon Hill Coal Co., at Carbonado, Washington, is now with the Kennecott Copper Corporation at Kennecott, Alaska.

Rienzi W. Macfarlane, assistant superintendent of the Longfellow division of the Arizona Copper Co. at Morenci, has been spending the past month near Parral, Mexico.

Lester E. Grant has been promoted to the managership of the Braden Copper Company, in succession to **S. S. Sorensen,** who goes to the New York office in a consulting capacity.

C. V. Jenkins, formerly business manager for the Nevada Con. Copper Co. at McGill, Nevada, and now connected with the New York office of the Jackling companies, is at Salt Lake City.

William R. Appleby, dean of the Minnesota State School of Mines, and **Edward W. Davis,** superintendent of the Mines Experiment Station at Minneapolis, are making a tour of Western mining districts.

THE METAL MARKET

METAL PRICES

San Francisco, September 28

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	18.75
Lead, pig, cents per pound	8.75—9.75
Platinum, pure, per ounce	$115
Platinum, 10% iridium, per ounce	$165
Quicksilver, per flask of 75 lb.	$75
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

September 27.—Copper is inactive and easy. Lead is quiet and lower. Zinc is dull and weak.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Sept. 21	94.12	59.87	Aug. 16	95.39	59.05
" 22	94.00	60.00	" 23	99.12	61.60
" 23	94.00	59.87	" 30	96.61	60.70
" 24	93.00	59.37	Sept. 6	93.27	58.90
" 25	93.00	59.50	" 13	93.96	59.15
" 26 Sunday			" 20	94.31	60.08
" 27	93.00	59.37	" 27	93.52	59.66

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	
May	99.50	107.23	102.69	Nov.	101.12	127.57	
June	99.50	110.50	90.84	Dec.	101.12	131.92	

COPPER

Prices of electrolytic in New York in cents per pound

Date		Average week ending	
Sept. 21	18.75	Aug. 16	19.00
" 22	18.75	" 23	19.00
" 23	18.75	" 30	19.00
" 24	18.75	Sept. 6	19.00
" 25	18.62	" 13	18.75
" 26 Sunday		" 20	18.75
" 27	18.50	" 27	18.70

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	
May	23.50	15.91	19.05	Nov.	26.00	20.45	
June	23.50	17.53	19.00	Dec.	26.00	18.55	

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Sept. 21	8.00	Aug. 16	9.06
" 22	8.00	" 23	9.19
" 23	7.87	" 30	8.85
" 24	7.75	Sept. 6	8.55
" 25	7.75	" 13	8.29
" 26 Sunday		" 20	8.06
" 27	7.75	" 27	7.85

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	
May	6.99	5.04	8.55	Nov.	8.05	6.76	
June	7.59	5.32	8.43	Dec.	6.90	7.12	

ZINC

Zinc is quoted as spelter standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Sept. 21	7.80	Aug. 16	8.27
" 22	7.75	" 23	8.42
" 23	7.75	" 30	8.45
" 24	7.70	Sept. 6	8.29
" 25	7.70	" 13	7.78
" 26 Sunday		" 20	7.83
" 27	7.70	" 27	7.73

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	
May	7.92	6.43	8.07	Nov.	8.59	8.12	
June	7.92	6.91	7.92	Dec.	8.49	8.69	

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Date	
Aug. 30	85.00	Sept. 14	75.00
Sept. 7	75.00	" 21	75.00
		" 28	75.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	
Apr	115.00	73.12	100.00	Oct.	120.00	86.00	
May	110.00	84.80	87.00	Nov.	120.00	78.00	
June	112.00	94.40	85.00	Dec.	115.00	95.00	

THE WORLD'S STOCK OF GOLD

From its London information service the Bankers Trust Co. has just received the following interesting study of the world's gold situation:

The table shows the gold holdings of the world's State banks and Treasuries at the end of 1913, 1918, and 1919, and also at the end of June last, and therefore gives a measure of the movement of gold money during the War. It is necessary to include, at any rate, one doubtful item —that of the Imperial Bank of Russia, for which no figures later than that of October 1917 (£129,500,000, or, at par, $629,370,000) is available, and the totals shown since that date are approximations much open to question. The last two amounts of $315,900,000 are based on the statement that the gold-reserve transferred to Omsk amounted on August 1, 1919, to 651,532,118 rubles. If the figures set down for Russia are too high, they affect the calculations in this statement accordingly.

The table is not exhaustive, since Greece, Rumania, Brazil, Uruguay, Peru, the Straits Settlements, and the banks of issue of Scotland, Ireland, Victoria, and New Zealand are not included; but if these were added they would probably account for £70,000,000 (at par, $340,200,000) at the end of 1913, rising to £85,000,000 at the end of 1915, and thereafter probably falling somewhat.

The addition of these further banks, however, would not materially affect the total of the table. The figures include gold held abroad:

In Millions of Dollars

End of	1913	1918	1919	June 1920
France	681.9	1,064.8	1,084.3	1,086.2
England	170.1	527.3	382.2	711.0
Spain	90.3	443.0	475.3	476.8
Russia	736.8	(388.8)	(315.9)	(315.9)
Reichsbank	333.9	549.7	264.9	265.4
Netherlands	61.2	279.5	258.1	257.6
Italy	215.3	158.9	156.5	(156.5)
Swiss	33.0	80.7	100.6	103.5
Sweden	27.7	77.3	75.8	70.5
National Bank of Denmark	20.4	52.5	61.2	61.7
National Bank of Belgium	48.6	52.0	52.0	52.0
Austro-Hungary Bank	251.3	(57.8)	46.6	53.5
Norway	12.6	32.6	39.4	39.4
Total Europe	2,686.1	3,754.9	3,512.8	3,650.5
U. S. Treasury	1,292.8	2,551.5	2,269.6	2,162.7
Argentina	224.5	268.8	295.5	405.8
Total America	1,517.3	2,820.3	2,565.1	2,568.5
Japan	109.8	352.8	463.2	476.1
India	103.5	64.2	128.8	148.7
Total Asia	213.3	417.0	592.0	624.8
British Colonies	175.0	300.3	316.8	298.4
Grand total	4,591.7	7,292.5	6,986.7	7,142.2

MONEY AND EXCHANGE

Foreign quotations on September 28 are as follows:

Sterling, dollars:	Cable	3.51
	Demand	3.51¾
Francs, cents:	Cable	6.76
	Demand	6.77
Lire, cents:	Demand	4.27
Marks, cents		1.75

Eastern Metal Market

New York, September 22.

There is very little change in any of the markets, most of them being inactive. Prices have receded slightly in some cases.

The copper situation does not improve but values are unchanged.

The tin market continues quiet and easy.

Lead has declined further in the East, due to the import situation.

There has been very little alteration in the zinc market.

Antimony is unchanged.

IRON AND STEEL

Developments both inside and outside of the steel industry have encouraged buyers in their waiting attitude, says 'The Iron Age'. The tendency toward an easier market is more apparent. Output of pig-iron and of steel products is increasing and October promises to figure again as a month of records. Both in the Pittsburgh and Chicago districts the Steel Corporation has added to the number of its active blast-furnaces. At Chicago its steel-ingot output is 85% of capacity. The railroad situation shows continued improvement and stocks at mills have been cut down—those of the American Sheet & Tin Plate Co. by 50%.

Price changes are not well defined. While the general tendency is for the higher prices on finished products to approach those of the Steel Corporation, one or two changes in the other direction are reported.

An exception to the general run of cancellations from automobile makers appears in several calls from such companies in the past week for the shipment of strip steel they had held up. However, the week has brought further reports of reduced melt by foundries dependent on the automobile industry, also of the cancellation of machine tools ordered for motor-car work.

COPPER

The fact that the copper market does not improve, as was expected, is a cause of speculation by many. In fact the moderate revival of inquiry which appeared recently has not augmented but has fallen off. There is very little domestic buying and the exchange situation is such that foreign business, which has been fairly good, has received a check. The volume of the latter is put at around 20,000 tons per month for the next three months, as based on recent sales. In the absence of sustained demand of any proportions prices depend largely on the seller. Some of the leading producers of both Lake and electrolytic copper still maintain their quotation at 19c., New York, while others take some business at 18.75c. Small producers and dealers are doing a little business at 18.25 to 18.50c., delivered. The tone of the market is not as confident as recently; some producers are pessimistic and are expecting curtailment in output, while others are still predicting a buying movement soon. The London market was easier early this week.

TIN

While there was a moderate business done last week, on the whole the market continues dull and featureless. The transactions referred to were mostly with dealers and involved September-October shipment, or metal for arrival this year, at around 45.50c. The week on the New York Metal Exchange has been a quiet one, total sales, including yesterday, amounting to only about 75 tons. The feature of this was the continued sales of 25-ton lots under the hammer. Business of this character has been heavy in recent weeks. Most of this metal in the last three days went at 44.37½ to 44.50c. There is reported a better demand for 99% tin. The weakness of the market on this side is explained as due to an abundance of spot Straits, which yesterday was quoted at 44c., New York, caused by heavy arrivals. Thus far this month the tin arrivals have been 3680 tons, of which only 285 tons is credited to Pacific ports. The quantity afloat is 4260 tons. The London market yesterday was down, with spot standard at £272 15c., future standard at £278, and spot Straits at £274 15s. There is also an ample supply of Straits tin in England and speculation is largely absent.

LEAD

The New York market is dull and there is little to say. General conditions have not changed and the situation is dominated by import metal, the arrivals being heavy. On Monday last week two steamers brought in 3500 tons. Demand is light but consumption continues very heavy. The imported metal has sold at 8c., New York, duty paid, which establishes the outside-market quotation, that of the Trust still standing at 8.50c., New York. No material change is expected soon and the weakness in exchange, which fell to $3.47 yesterday, does not help the situation. The Western market is quiet and stable at the level of the leading interest, or 8.25c., St. Louis.

ZINC

The market is marking time and there has been very little change in values. The London and import market situations are dominating factors. So mixed is the situation in the East that it is difficult to quote values. A fair appraisal seems to be 7.80c., New York, for imported metal, with some domestic, possible re-sale, offered at 8.15c., New York. The St. Louis market is 7.75 to 7.85c., with demand now fallen to the hand-to-mouth order. The betterment in galvanizers' needs has fallen off again and was evidently only for temporary replenishment of stocks.

ANTIMONY

The market is inactive, with wholesale lots for early delivery quoted at 7.12½., New York, duty paid.

ALUMINUM

Wholesale lots of virgin metal, 98 to 99% pure, are available at 34.90c. f.o.b. producer's plant, with foreign metal offered at 31 to 32c., New York.

ORES

Tungsten: The week has been a quiet one, though there has been some ore offered which did not result in buying. Quotations are practically unchanged and nominal at $5 per unit up.

Ferro-tungsten is in quiet demand at 80c. to $1.05 per pound of contained tungsten.

Molybdenum: Conditions are unchanged in a very dull market with quotations nominal around 70c. per pound of MoS_2 in regular concentrates.

Manganese: There is no demand. High-grade foreign ore is offered at around 65c. per unit, seaboard, but consumers appear unwilling to pay more than 55c. per unit and are probably amply supplied.

Manganese-Iron Alloys: There is very little demand for either ferro-manganese or spiegeleisen and prices are unchanged. Both British and American ferro-manganese are available on a basis of $170, seaboard. There has been a sale of 500 tons at $170, seaboard, for early delivery, and one of 300 tons of spiegeleisen at $82.50, furnace. Aside from these, sales are confined to a few small lots and inquiry is very light.

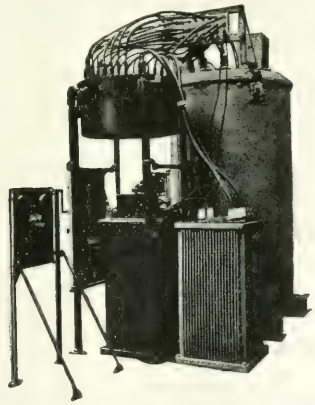
Ferro-silicon: The market for 50% alloy is quiet at $75 to $85 per ton, delivered, while the electric 14 to 16% alloy is in fair demand at $65 per ton.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

STEP INDUCTION REGULATOR FOR ELECTRIC FURNACE VOLTAGE CONTROL

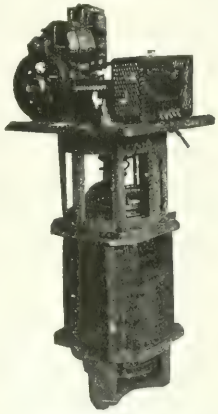
For controlling the energy in-put for carborundum, graphite, aluminum, zinc, and similar types of electric furnaces, the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., is manufacturing a step-induction regulator which gives a uniform voltage over a wide range. The regulator consists of a furnace-transformer, an induction-regulator, switches, and push-button control. This apparatus utilizes the principle of varying the high-voltage tap on the transformer for controlling the energy-input to the furnace. The function of the induction-regulator is to vary



Step-Induction Regulator Complete with Transformer and Control-Panel

the voltage between taps. After the voltage of the adjacent tap is reached the selector and transfer-switches automatically transfer the induction-regulator so that it will function between the next two taps. One of the main features of this apparatus is that the entire voltage-range is controlled by two push-buttons, one for boosting and one for bucking the voltage.

The construction of the apparatus is as follows: On the shaft of the regulator is geared a selector-switch, the joints on this switch being connected directly to taps on the high-voltage winding of the furnace-transformer. The selector-switch arm moves from one contact to the next, automatically, as the induction regulator moves. The function of the feeder-voltage regulator is to add to or subtract from the normal voltage of a transformer-tap and is designed so that at the position of maximum boost it will add exactly one-half of the voltage between adjacent transformer-taps, while at position of maximum buck it will subtract exactly one-half the voltage between adjacent transformer-taps. Considering, then, a single position of the selector-switch arm, a single rotation of the moving coil of the induction-regulator will vary the voltage impressed on the high-tension winding from a position one-half step below to a position one-half step above the voltage point actually represented by the transformer-tap. The selector-switch arm is moved from one tap to the next just as the voltage one-half way between adjacent taps is reached, so that continued rotation of the regulator coil produces a continuous



Motor-Operated Regulator

variation, raising or lowering the voltage depending only on the direction in which the regulator coil is being turned.

While the above is the fundamental operation of the apparatus, in actual practice there are slight modifications. The moving coil of the regulator makes but one-half revolu-

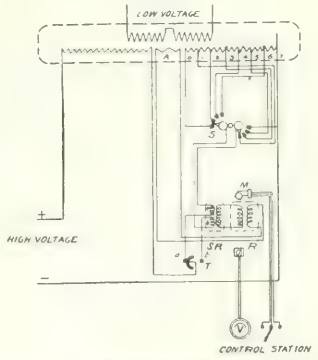


Diagram of Connections

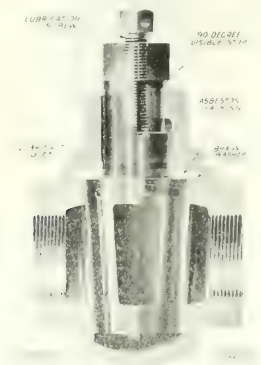
tion to go from the position of maximum buck to the position of maximum boost, at which latter point the selector-switch moves to the next higher voltage-tap, and the regulator must be brought at this point to maximum buck before it can, by continued operation, raise the voltage over another step. That is, at this point, the direction of current

through the regulator coil must be reversed. Actually, the result is obtained by a second coil of opposite polarity which is cut in at the proper time by a transfer switch and the regulator changes directly from maximum boost to maximum buck, so that continued rotation still acts to raise the voltage. The two-coil arrangement also makes desirable two-selector switches geared together for continuous variation of the voltage. With high incoming line-voltage a series-transformer is interposed between the high-tension line and the induction-regulator. This allows the use of a less bulky low-voltage induction-regulator, and ensures against trouble with insulating moving parts for high potentials. In this case, two coils are incorporated with the series-transformer instead of in the regulator itself, and accomplish the same current-reversing purposes. The operation of this regulator may be seen by references to the schematic diagram.

THE MERCO NORDSTROM PLUG VALVE

The taper plug-valve, when properly constructed, is undoubtedly the most efficient form of valve for universal use when it works. When, on the other hand, it sticks and binds in its seat, it becomes one of the most 'onery' pieces of mechanism that it is possible to imagine, and has probably spoiled the tempers of more good mechanics than any other one cause.

S. J. Nordstrom, a mechanical engineer engaged at Mexico City in the design, construction, and operation of cyanide



Phantom View of the Merco Nordstrom Valve

plants, was impressed with the obvious defects and shortcomings of valves in handling cyanide solutions and slime in the concentrating plants and mills of Mexican mining centres. Mr. Nordstrom saw that the difficulty with all forms of patent lubricated plug-valves was that, given a perfect fit between the valve and its seat, there was no possibility of forcing grease into a space which did not exist, namely, that there was no clearance between the valve and its seat. He saw then that it was necessary to design a valve in such a way that the lubricant itself could be used to lift the valve from its seat so as to allow clearance and a consequent spreading of the film of lubricant over the surface of the valve-seat. Having arrived at this conclusion, the present design of this valve soon worked itself out as a closed plug-cock with chamber at the bottom of the valve-seat, a receptacle for grease in the shank of the plug connected by drilled ducts with channels in the taper sides of the plug, which channels continued to the bottom of plug, thereby connecting with the chamber when the plug was seated in the valve.

References to the illustration will show clearly the working principles of this valve. The phantom-view showing the plug exposed indicates the action of the grease. Considering that the grease-chamber at the bottom, the grease-channels, the grease-duct, and the cylindrical space underneath the end of the lubrication-screw are entirely filled with lubricant, and considering also a perfect fit between the plug and its seat, it is evident that a slight turn of the lubrication-screw will exert a tremendous hydraulic pressure upward on the bottom of the valve-plug. It will be noted that the cap which is held down by bolts at either side (not shown in the illustration) forms a tight joint through an elastic packing washer. The valve-plug is so machined that when seated in the valve its faced shoulder is slightly lower than the facing on the edge of the valve-cage. When, therefore, the cap is clamped down tightly, it makes first a tight joint on the edge of the valve cage and the elastic packing is lightly pressed against the anti-friction washer on top of the plug facing, leaving sufficient elasticity in the packing so that the hydraulic pressure mentioned above raises the plug by an infinitesimal (but sufficient) amount to allow clearance for a film of grease between the plug and the seat. It is in this hydraulic lifting action that this valve is differentiated from all other lubricating plug-valves, and it is right here that its success lies.

Iron valves of this type have been tried out in a sal-ammoniac solution, closed for two months so that they were practically rusted solid, and one turn of the lubrication screw was sufficient to allow very easy turning of the plug. A ninety degree stop is arranged between the shank of the plug and the valve cap, and this stop has an extension above the valve cap so that the operator can see at a glance just how the valve should be turned and when it is open and shut. This stop is so positioned that the grease channels on the sides of the plug can never be open to the action of the liquid which is being handled. The Merrill Co., which is distributing this device, expects that it will be found especially useful in handling cyanide-solutions and in marine work.

COMMERCIAL PARAGRAPHS

The Main Belting Co., manufacturers of 'Leviathan' and 'Anaconda' belting, are issuing 'Conveyor Problems and their Solution', which they describe as "a practical consideration of accepted conveying-practice as developed by engineers of authority, illustrated by notable examples of scientific belt-conveying". The illustrations are good and the examples of typical arrangement are plentiful. The booklet should be both interesting and useful to those who have conveyor problems requiring solution.

Ruggles-Coles Engineering Co., of 50 Church street, New York, announces the temporary discontinuance of its Chicago office, formerly at 332 South Michigan avenue. All inquiries, orders, and other communications previously directed to that branch will be attended to by the New York office. It also announces the opening of new sales offices in the Newhouse building, Salt Lake City, Utah, and in the Old National Bank building, Spokane, Washington, where inquiries and requests for information will be given prompt attention.

Oliver Continuous Filter Co., manufacturer of the Oliver continuous filter, dry vacuum pumps, air-compressors, etc., has appointed J. F. Mitchell-Roberts as its special representative to better serve its constantly increasing clientele in England and Europe. Offices have been established at No. 2 Broad Street Place, London, E. C., 2, England. In connection with its offices at 33 West 42nd street, New York, and 503 Market street, San Francisco, California, this company maintains laboratories for investigation of filtration problems, and similar arrangements will be made at its new London office.

T. A. RICKARD, - - - - Editor

NINE HUNDRED miners, it is reported, are coming to the United States from Spain. They represent the orderly element among the men on strike at Rio Tinto, as described in these columns on September 4. Incidentally, we note that the Rio Tinto company has passed its dividend.

CLAIMS aggregating $5,826,655 have been decided by the War Minerals Relief Commission; on these 31.64%, or $1,843,887, has been allowed. As 994 claims have been decided and 769 have been rejected, there can not be more than 200 remaining for consideration by the Commission. We have heard of only one claim, from Alaska, that has been paid in full.

THE 23rd annual convention of the American Mining Congress, at Denver, during the week beginning November 15, will be signalized by a conference on the standardization of mining machinery, equipment, and labor-saving devices. Other subjects to be discussed will be taxation, the McFadden Bill, War Minerals Relief Commission, the petroleum industry, and the commercial and legal phases of the flotation process.

QUESTIONS concerning assessment work are becoming frequent as the end of the year approaches. Miners want to know whether they still can take advantage of the abatements allowed during the War. The answer is in the negative. All the joint resolutions relieving the owners of mining locations from doing assessment work as heretofore required by law are now ineffective. There is only one possible exception and that is the joint resolution approved by the President on July 17, 1917, whereby officers and enlisted men in the service were relieved of the obligation to do assessment work on their claims for a period of six months after being mustered out of the Army or Navy.

APROPOS of the interesting article in this issue by Mr. A. B. Parsons, it may be mentioned that at some mines concrete is believed to be the only kind of support capable of holding heavy ground. For example, a portion of the Snake Creek tunnel, in the Park City district, which will ultimately connect with the shaft of the Judge mine at a point 5000 feet from the portal, is lined with concrete. The cross-section is egg-shaped and the reinforcement is carefully designed to assume the tensional strains, while the compression is provided for by the concrete. The arch of the adit is only one-third as wide as the Butte & Superior station, but, of course, the character of the ground in the two localities is different.

REFERENCE to new methods of flotation, more particularly patented discoveries that do not involve the use of oil, are frequent in the daily and semi-technical press. Such announcements, not unnaturally, are accompanied by the pious hope that the non-use of oil will permit the owners of mines to escape the impositions and exactions of the Minerals Separation people. This is too optimistic. Besides patent No. 835,120, which covers the use of less than 1% of oil, the Minerals Separation company owns patent No. 962,678, covering the use of a soluble frothing-agent, which is one of the points involved in the Miami lawsuit. It may be possible to find a frothing-agent that is not soluble, but it is difficult to conceive of any way of modifying the surface-tension of water by means of an insoluble substance. Of course, everything in nature under special conditions is more or less soluble in water; that exemplifies one of the iniquities of the patent system, under which claims of a perfectly absurd comprehensiveness are granted without any appreciation of their meaning.

RICH ORE has been found at Ely under exceptionally interesting conditions. A reference to the discovery was made last August in the 'Boston News Bureau', which quoted Mr. Louis Ross, a mining engineer of distinction. The Boston paper exaggerated the dimensions of the orebody and thereby threw doubt upon the accuracy of the news. A local paper, the 'Ely Times', published a brief article on the subject, and we made mention of it in our news columns two weeks ago. As a matter of fact, we learn the discovery is both important and significant. During the latter part of July, while the 700-foot level in the Ruth mine, of the Nevada Consolidated, was being driven from the Star Pointer shaft, a high-grade mass of sulphide ore was cut. The first assay showed 8% copper, but after about 70 feet of advancement the assays improved to 13%. This ore is in the lime-shale, near the contact with the monzonite-porphyry; it is at a horizon below the zone of secondary enrichment marked by the disseminated chalcocite; it appears to be an enrichment of the primary chalcopyrite. It is ore rich enough to be smelted without previous concentration in a mill. No estimates of tonnage are available, but we are

informed that the work so far done has exposed a large body of rich ore. The event is encouraging to the so-called porphyry copper group, for it points at the possibility of bonanzas being found even in mines characterized by enormous tonnages of a uniformly low-grade ore.

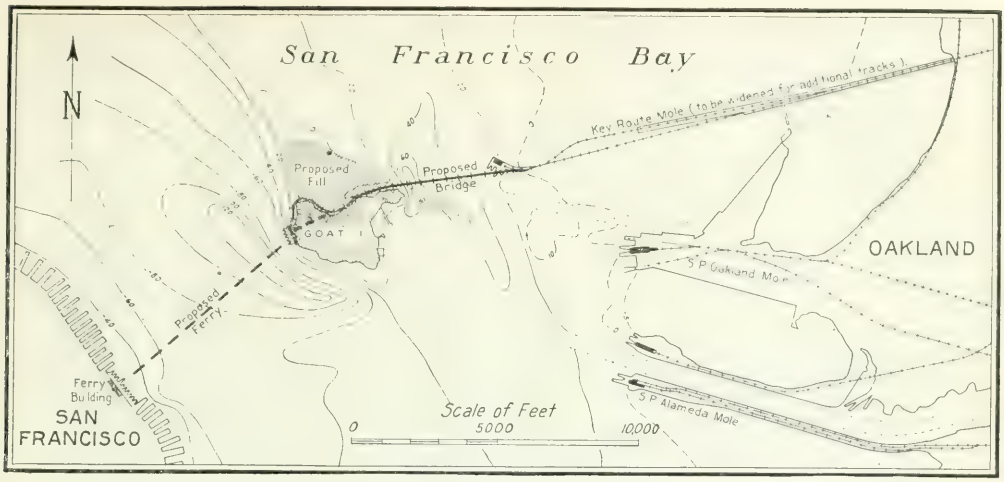
AT the recent congress of the European Socialists belonging to the so-called Second International, at Geneva, a revision was made of the definition of the term 'Labor'. It was declared by the Congress that it included not only the manual working wage-earners, but also intellectual workers, independent handicraftsmen and peasants, and "all those who personally co-operate in the production of utilities of any sort". Therefore the term excludes, it is declared, "among healthy adults, only those who idly live by owning". The French call them '*rentiers*'; we call them the 'idle rich', who toil not neither do they spin. The British Labor party, two years ago, adopted the phrase "workers by hand or by brain", and we prefer it to the Genevan definition. In any event, we are glad to be included in the category of the workers. It is about time that the manual laborer understood that the work of the world is done by many kinds of men, and that the best work is that which is most intelligent.

SHORTAGE of the right kind of men, presumably, has led the Canadian Geological Survey to engage women. Two lady geologists are reported to be in the field. They ought to be able to collect all the information necessary for a useful report; indeed, they are said to carry a gun and a revolver as part of their outfit, so that if anybody is slow in coming forward with the necessary data they will be in a position to exercise persuasive powers of more than usual feminine effectiveness. We shall expect sundry distinctive touches in the writings of these ladies, and the introduction of new descriptive terms. For instance, they are likely to find pleats in the shale, ruching in the rhyolite, and tucks in the trachyte. Stranger things have happened. The 'selvage' of a vein is akin to the 'self-edge' of a piece of cloth. 'Seams' came into mining by grace of the seamstress. Joking apart, geologizing by women is no new thing. The oldest Geological Society, namely the one in England founded by Lyell and Murchison, includes a considerable number of the gentler sex. Many of them have contributed valuable articles to the proceedings. Geology used to be considered a polite study, it was one that was untainted by commercialism, it appealed to gentlemen and ladies, that is, to amateurs. And that is why the geology of the Victorian period in England contributed so little to the aid of mining. The geologists of both sexes looked askance at any phase of their subject that touched on money-making. They delved in fossils, they delighted in glacial drift, they enthused over stratigraphic difficulties. All that is changed, and the ladies too. Undoubtedly the new recruits to the Canadian Survey will have an eye to the economics of their subject; they will be in sympathy with the miner, and they will collect the data helpful to him in his search for metals. We welcome them with the grave courtesy suitable to the occasion. There is plenty of work for men to do; many of them are doing the work that women can do; it is well that there should be a proper distribution of talent and energy into suitable channels.

THE average American who thinks he is fairly familiar with the geography of his own country may find that some of his ideas regarding locality are gained from impression rather than from precise observation. For instance, a good many may be surprised to realize that the Island of Cuba if transposed directly north would extend from New York City to central Indiana; and that the town of Nome in Alaska is farther west than Honolulu. Some will even be mildly astonished to learn that part of Minnesota is more than 100 miles farther north than the uppermost end of Maine, and that San Diego is farther east than Spokane, in eastern Washington. The explanation is that the meridians and parallels of latitude on most of our maps are curved lines, whereas we unconsciously imagine a set of rectilinear co-ordinates. The Geological Survey recently has compiled numerous data regarding the extent and area of the United States. The extreme north and south dimension is 1598 miles, which is the distance from the southernmost part of Texas due north to the Canadian border; the maximum breadth is 2807 miles, from West Quoddy Head near Eastport, Maine, to the Pacific. The shortest distance from the Atlantic to the Pacific is between points near Charleston and San Diego, a distance of 2152 miles. The length of the Atlantic coastline is more than twice that of the Pacific, but this is, of course, due to the configuration of our eastern shores. This does not, however, include the Gulf of Mexico, which itself borders the United States for 3640 miles as compared with 2730 miles touching the Pacific and 5560 the Atlantic. The gross area of the United States is 3,026,789 square miles, of which 2,973,744 is land and 53,015 is occupied by rivers and lakes, exclusive of the portion of the Great Lakes that is included in our territory.

Crossing the Bay

During the past week the old problem of improving transportation across the Bay of San Francisco has been brought again into public notice by sundry suggestions proffered by Rear-Admiral Joseph L. Jayne, who has just retired as commandant of the Twelfth Naval District, which includes the station at Mare Island, near San Francisco. The subject is one of more than local interest; San Francisco is the chief port of entry on the Pacific coast of North America; it is a gateway on the main line of travel to the Orient; it is one of the most interesting cities in the world and is situated on a bay famous for its beauty. Every mining engineer has been here or hopes to come here some day. We need not apologize for discussing an engineering project the purpose of which is to facilitate passenger traffic between the mainland and the peninsula at the northern end of which San Francisco stands, "the warder of two continents". The metropolis of California has a population of 508,000; on the opposite shore are the towns of Alameda, Oakland,



SKETCH SHOWING ADMIRAL JAYNE'S PROPOSAL

and Berkeley with a total population of 300,000. The trans-bay cities, as they are called, are the bedrooms of San Francisco; most of their inhabitants come to San Francisco to do their business. About 50,000 persons cross the bay daily. These include others besides 'commuters', for the transcontinental railways have their termini in Oakland. The chief problem is the handling of the purely local traffic, more particularly in the morning and evening. At the present time the crossing is effected by means of three ferry systems, linking the suburban electric-railway terminals with the wharves that extend beside the Ferry building at the foot of Market street, which is the main artery of San Francisco. The distance across the water is three miles and it is crossed in 17 to 20 minutes. During the rush hours the ferry-boats are crowded; at other times there is an unnecessary duplication of service; moreover, automobiles are transported only by one slow, expensive, and indirect ferry system, by way of the Oakland estuary, so that motor traffic is subject to many unpleasant delays and exactions.

Admiral Jayne's proposal, briefly, is this: To erect a steel trestle from the end of the Key Route pier to Goat island, the real name of which is Yerba Buena. This trestle is to be high enough to allow the passage of small vessels. The island is to be pierced by a tunnel through which trains will pass to a site to be graded on the western side, where a union station will be placed. This terminal will have facilities ample for the transcontinental railroads as well as the suburban cars. Docks will be built here, and from them the ferries will ply to the San Francisco landing, only a mile and a quarter distant, as against the present ferriage of three miles. The island is the property of the Federal government; as early as 1869 the Southern Pacific Railway company tried to obtain the use of it for a terminus, but the railroad company at that time was so associated with predatory politics that strong opposition was offered to the proposal. To allow the island to be used by a number of traction companies, and for the general benefit of the community, is quite another matter. We give a sketch showing the local topography, including soundings, which are important. It will be noted that a shoal extends as far as the present Key Route terminus, which is separated from the island by a narrow stretch of deep water. On the western side the water is also fairly deep, shoaling in the approach to San Francisco, the eastern part of which, as far as Montgomery street, is built upon a fill. How this system of transportation will be completed is another question. A tunnel of the tube type would be impracticable on account of the contour of the bottom. Various plans for a bridge have been proposed. In 1914 Mr. Charles E. Fowler suggested a cantilever structure from Goat island to Telegraph hill in three main spans of 2000 feet each, with a clearance of 150 feet at high tide. He estimated the cost at $75,000,000. He proposed a cantilever bridge on the eastern side of the island, as Admiral Jayne does, connecting with a causeway. Six years ago it was estimated that 60,000,000 passengers would cross the Bay in 1925 at a cost of 5 cents; today 43,000,000 passengers are crossing annually at a cost of 9 cents apiece per trip, this being half the total cost of the journey from the suburban cities to San Francisco. Commuters pay $4.80 per month. The toll has undergone a series of increases from the 5 cents levied, for ferriage only, before the War, when commuters paid $3 per month. In 1916 a bridge 30,200 feet long, from Oakland to San Francisco, was proposed by Mr. Wilbur J. Watson, at a cost of $25,000,000. A double-tube tunnel from the Oakland mole of the Southern Pacific to the Ferry building in San Francisco was estimated by Mr. Taggart Aston to cost $15,000,000. The top of this tunnel was to be 45 feet below low water; it was to be 15,480 feet long, to which was added 11,370 feet for the approaches. It would take, it was estimated, only 20

months to construct, and would be less subject to damage by earthquakes than a bridge; but it includes no provision for motor traffic. This is becoming an increasingly important factor. It might be solved by carrying the cars on electric 'mules', or trucks, through the tunnel; but this would be much less pleasant than a bridge-crossing. No project can be undertaken without the concurrence of the Federal government, through the War Department, which exercises control over harbors. The interference with the tidal currents must be considered; also the effect of seismic disturbance. The Admiral's scheme is estimated to entail an expenditure of about $15,000,000. It should include an enlargement of the causeway to the island, so as to provide for motor traffic. The tunnel through the island proposed by the Admiral is unnecessary, the shoal at the northern end of the island affording obvious opportunity for a fill ample for the purpose of a terminal station and docks. Any increase in the number of ferry-boats on such a short run as the mile separating the island from the City would augment the danger of collision, and for that reason among others it would be desirable to use large boats rather than the small ones, especially on the Key Route service, now running. In that event three or four vessels might suffice, if they made the journey in ten minutes, as seems likely. Thus ten minutes would be saved, besides the present duplication of service, creating an expense that is being passed, naturally, to the passengers. Whatever plan be adopted, the automobile traffic must be considered. At present the toll on automobiles is $1.22 per crossing, or $2.44 for the round trip, to which the passenger rate of 8 cents per person must be added. This is excessive, but the worst feature is the loss of time; the crossing from Oakland takes 45 minutes and the inadequacy of the space on the boats causes long waits, especially on holidays. In all schemes of inter-urban traffic nowadays it is necessary to make provision for automobiles. In California there is an average of one motor-car per seven persons. The suggestions made by Admiral Jayne have been received most favorably by the various municipal authorities and it is to be hoped that they will co-operate for the purpose of a consummation.

Industrial Relations

In a recent issue we discussed the book on 'The Great Steel Strike', written by William Z. Foster, who was largely responsible for that industrial conflict. We have received a reprint of an article by Mr. Charles Piez on the same subject. Mr. Piez was Director General of the Emergency Fleet Corporation during the War and proved himself a man of high character and remarkable ability; he is now president of the Link-Belt Company. He criticizes the report of the commission appointed by the Interchurch World Movement and says, quite fairly, that the members of that commission made a fundamental mistake in assuming or concluding that the strike "was waged wholly in the cause of hours, wages, and control of jobs, and over the manner in which all these matters were determined". On the contrary, he insists, and we agree with him, that "the steel strike was but one of a series of broad industrial disturbances that were deliberately designed to wrest the control of industry from its owners, and place it in the hands of the radical element of organized labor". The statements made by Foster in his book prove this inference unmistakably; to him "the wage system is the most brazen and gigantic robbery ever perpetrated since the world began". Mr. Piez refers to the strike of the shipyard workers in January 1919 and describes the conditions under which it was started; how the men broke their agreement with the Emergency Fleet Corporation, which was a war-time Government agency; no question of hours or of working conditions was involved; the aim of the leaders, mostly aliens, was to secure the control of industry in the Puget Sound district, just as Foster and Fitzpatrick started the steel strike in order to attack the 'open shop', and to aggrandize themselves personally. We have to part company with Mr. Piez when he compliments Judge Gary. He says: "We have had many examples in the past two years of the effects of unlimited power in the hands of arbitrary, unwise, and selfish leadership". This, it seems to us, describes Mr. Gary as well as Mr. Foster. If labor and capital are to be reasonable in their demands, if they are to show a just appreciation of each other's rights and privileges, it will hardly be under the leadership of such opposing chieftains. We come back to the side of Mr. Piez when he animadverts upon the breaking of agreements made by the unions and the too frequent exhibition of a bolshevik contempt upon their part for the sanctity of contractual relations. If collective bargaining is to be honored in observance, it must be by a scrupulous recognition of the obligations incurred on both sides. An employer places his property in jeopardy when he dishonors his written word; it is not fair that the employee collectively should be able to ignore his own obligation with impunity. Indeed, the failure 'to play the game', to give a square deal, is at the bottom of most of our industrial troubles. When a man accepts a job at a given wage he tacitly engages to perform the day's work, and the honest workman does it; but the union, or the agitator who tries to control the union, discourages the idea of carrying out the implied agreement, encouraging the slacker, with the idea of decreasing the amount of work done for the wage, thereby thinking to leave more work to be done by others. This is as dishonest as getting ten hours work from a man for eight hours pay. In these matters fairness and honesty go hand in hand. Arbitrary action on either side is out of date. The public will support no side that deals unfairly, but unfortunately the public is rarely well informed, and therefore is unable to react until too late. The problem that faces the thoughtful student of economics, as Mr. Piez says, is "to appreciate the relative value of the three factors in industry, namely, capital, labor, and management, and to find a way of determining the compensation due to each". Obviously the community ought to compensate generously, in money and in honor, the men by whose humane and intelligent management the proponents of capital and labor can be brought into friendly harmony and joint efficiency.

THE BUTTE & SUPERIOR MINE, AT BUTTE, MONTANA

Mining Methods at the Butte & Superior

By A. B. PARSONS

This article will describe the methods of mining wide veins of rich zinc-lead-silver ore in heavy swelling ground, and sundry other features of the underground operations of the Butte & Superior Mining Co. in its mines at Butte. The Black Rock, as it is known locally because of the weathered outcrops of quartz-monzonite, is the most northerly of the productive mines in the district; in fact, it is situated beyond the line that was thought less than fifteen years ago to mark the limit of possible ore deposition; a belief on which certain well-known geologists were prepared to stake their professional reputations. However, in spite of the theory then prevailing, Capt. A. B. Wolvin in 1906 persisted in sinking on a rather hungry-looking lode with the hope of developing a copper mine. In this he was disappointed; but he did open a good vein of zinc ore. Like most mines that have become big producers, the Black Rock had its ups and downs until Capt. Wolvin sold the property and the present corporation was organized to work it in 1910. After a series of tests in an old mill at Basin, 20 miles south, on the Great Northern railroad, a concentrating-plant at the mine was completed and production on a reasonably large scale was commenced in the summer of 1912. The market for zinc at that time was dull and not until toward the end of 1914 did prices advance sufficiently to stimulate output. During 1915-'16-'17-'18 operations were fully extended. So urgent was the demand for production that some of the mining was hardly in accord with the best practice, although it was entirely justified by the condition of the zinc market. The miners and foremen, as a matter of course, followed closely the local practice that had been developed during 25 years of mining the copper ore in the district, and while it was recognized that the procedure was not always best adapted to the conditions it was also understood that any departure therefrom would be attended by disruption of the plan of operations. However, beginning with 1919 much attention has been devoted to establishing a more efficient system of mining and methods conducive to greater economy.

The Rainbow lode, which is the source of the bulk of the ore, varies in width and grade; in places it is divided into distinct branches by numerous faults, so that individual stopes vary in breadth from a single set to as much as 15 sets, that is, from 6 to 110 ft. While there is a general dip to the south, the irregularities are such that the ore-shoots are virtually perpendicular in so far as mining operations are concerned. The dip has changed materially in depth and shoots that were in No. 1 shaft at 1300 ft. are found near No. 2 on the 2200-ft. level. See Fig. 1.

There are now three vertical shafts. No. 1, the oldest, bottoms in a sump just below the 2050-ft. level; it has four compartments, two for hoisting ore and handling

the regular work, one for the cage of the 'chippy', or auxiliary hoist, and a fourth that serves as a manway and contains pipes, electric-cables, and ladders. Work on this shaft progressed steadily after 1907; it reached 1920 ft. in 1915, being in ore from the 1300 to the bottom level. It was through this shaft that all the ore was hoisted during the active years, 1915 and 1916, the largest output for a single month, 55,000 tons, having been recorded before either of the other shafts came into use. In the latter part of 1915 two new shafts were started at points indicated on the accompanying map of the 1600-ft. level, Fig. 1, about 60 ft. apart and some 500 ft. from No. 1 shaft. They were sunk vertically on what may be considered the hanging-wall side of the Rainbow lode, and in ground that was expected to be strong. Proximity to the new coarse-crushing plant of the mill was one consideration in selecting the site for the new shafts; facility in the distribution of supplies was another.

Both shafts have three compartments, including two for hoisting, and a manway. No. 2 is the largest, the main compartment measuring 17 ft. 1 in. by 7 ft. over all, as compared with 15 ft. 1 in. by 7 ft. for No. 3. No. 1 shaft has three hoisting compartments each 4 by 5 ft. Much of the work, in both of the new shafts, was done by raising from levels already established. At the present time No. 2 shaft has been driven to the 2300-ft. level; which is 300 ft. below the present sump of No. 3, to which a connection will be made by cross-cutting and raising. This procedure will reduce to the minimum any delay in current operation through No. 3, which is now the main working-shaft. No. 2 shaft has no skip-chutes and accordingly is not used for hoisting ore, all of this work having been done through No. 3 since 1917. Men and timbers are carried through No. 2; waste is transferred between levels; the main electric cables, air-lines, fresh-water lines, and the pump-column from the principal underground pumping-station occupy the third compartment. This shaft is up-cast and is equipped with a carefully designed system of fire-protection, including automatic sprinkler-heads.

Unfortunately, the ground penetrated by No. 2 shaft was not so good as had been hoped and a great deal of repair work has been necessary to maintain it in operating condition. Even at a distance of 50 or 60 ft. from the vein the ground, which is composed of soft granite, is blocky and slakes readily on exposure to the air. It is continually subject to movement. To facilitate the work of maintenance the worst places in the shaft have been protected with jacket or easing sets, following out the plan adopted in No. 1, where several hundred feet have been timbered in this way. The purpose is to enable necessary alterations to accommodate the changing ground, without disturbing the inner timbers. The method is not a new one, but the need for it emphasizes the exceptionally difficult ground that characterizes all the Butte & Superior workings.

The standard shaft-timbering prior to 1917 had always been regular rectangular sets, with wall and end-plates of 12 by 12-in. timbers, and dividers of 8 by 12-in. material. These were spaced at four or five-foot centres, and lagged with two-inch and three-inch plank. In an effort to decrease the excessive cost for repairs and maintenance, considerable study was given to the question of developing a better method of shaft-timbering. The plan used in the last 450 ft. of No. 2 shaft has proved so satisfactory that the same method will be employed in the further extension of both the new shafts. It is similar to the cribbed timbering used in the old Comstock mines. This cribbing is of 12 by 12-in. timbers with a half-joint at the corners; the timbers are laid skin-to-skin, but are not drifted together. The result is a solid casing of 12-in. material with the necessary dividers between compartments. The comparative first cost is slightly in favor of the old method as against the cribbed sets; the regular timbering requires less material than the sink-to-skin methods but more work in the framing-shop; the hangers are expensive, whereas the item of labor for doing the actual timbering underground is approximately the same either way. When each layer has been thoroughly blocked against the walls there is practically no chance for local movement in the rock, and the collective strength of the entire structure is sufficient to withstand unusual pressure even on considerable lengths of shaft. By filling behind the timbers, the bad effects of slaking ground are largely obviated. Continual repairs due to broken lagging are avoided, and cracked end-plates or wall-plates are improbable, since any strain is distributed over a considerable number of large timbers. A shaft of this kind has most of the good features of one lined with concrete, and in exceptionally bad ground there is the added advantage of affording an extra degree of elasticity.

This last point has been illustrated in the timbering of stations as well as in the constructing of fire-doors and bulkheads at various points throughout the mine. The accompanying drawing, Fig. 2, shows two methods used for timber support at the regular shaft-stations. The usual excavation is 18 ft. wide by 14 ft. high in the centre; it runs back from the shaft for six or seven sets, spaced with 5-ft. centres, if the timbering is done as shown in the right-hand sketch. This trussed-set construction is the old standard station-set used largely in the Butte mines. The principal members are all of 12 by 12-in. material with 5-in. lagging on top of double caps, and 5-in. flooring as shown. This type of station did not prove satisfactory in the Black Rock mine. Not only were the double caps unable to withstand the excessive weight, but swelling of the ground frequently caused the floor to buckle to such an extent that expensive repairs became necessary, particularly where there was no skip-chute beneath the floor. The left-hand sketch shows part of a station timbered according to a design developed upon the same theory as that applying to the cribbed shaft-timbering. A number of such stations have been constructed, with excellent results, where there is no reason to believe that the conditions are less severe. Apparently, the skin-to-skin arch-type has proved its superiority over the other in bad ground. There was one particularly doubtful station on the 1200-ft. level at No. 2 shaft, where, as an experiment, a circular arch of solid concrete was built surmounting concrete walls. Forms were con-

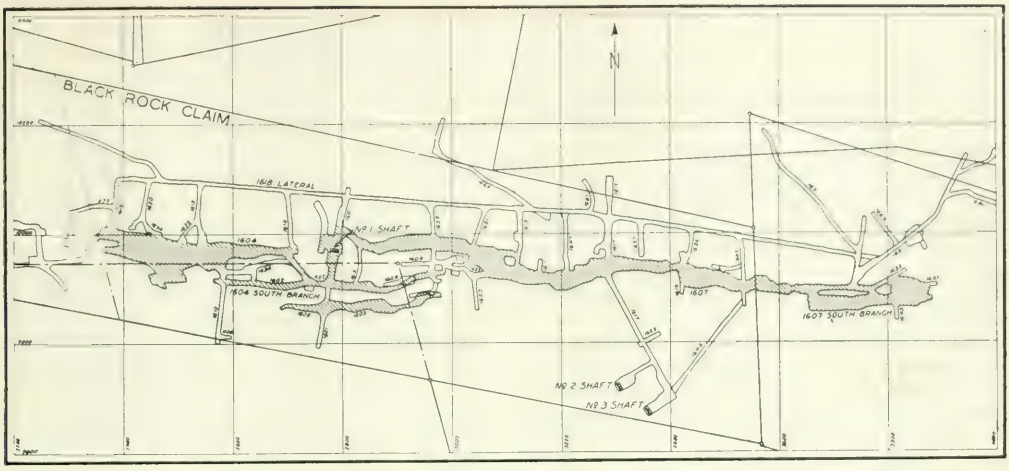


FIG. 1. PLAN OF 1600-FT. LEVEL

structed and concrete to a thickness, in places, of 5 ft. was 'shot' into position with a large-sized cement-gun. The walls and arch practically formed a well reinforced monolith, tight against the rock of the excavation. Only a few months later a large crack developed running the full length of the station near the top of the arch. Later other cracks started and a large section was about to fall in when measures were taken to support the concrete with timber. Whether the six-member timber-arch construction would have given better service at this particular place is, of course, uncertain, but the chances are in its favor. This illustrates the point that the extreme rigidity of concrete may easily prove disadvantageous when subjected to underground conditions. It is interesting to note that most of the companies in the Lake Superior copper region are abandoning the use of concrete for supporting the workings after spending hundreds of thousands of dollars in an effort to use it successfully. The experience there has been that the shifting ground causes the concrete to crack and crumble, thereby becoming not only useless but dangerous. The valuable feature that concrete is fireproof is largely offset by the use of gunite applied with the smaller cement-gun, which will be described later.

As stated before, there are skip-chutes at each of the stations at No. 1 shaft, and at those below the 1200-ft. level of No. 3. These vary in size from an actual working capacity of less than 100 tons up to 150 tons. The regular chute has no unusual features. The front is one set behind the timbers of the shaft and is lined with 4-in. plank faced with steel plates half an inch thick. The sloping bottom is of similar construction, whereas the timbered sides are 'bricked' with 12 by 12-in. square blocks, cut two feet long and placed so that the ends rather than the sides get the wear. The station-floor rests on 12 by 12-in. timbers spanning the chute, and the gates

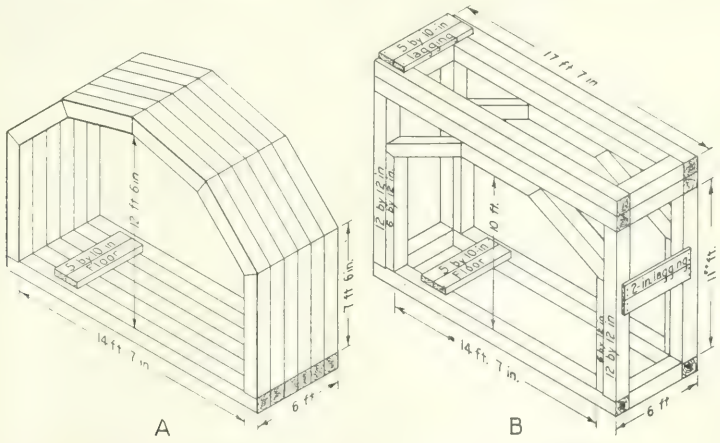


FIG. 2. PRESENT (A) AND FORMER (B) TYPES OF TIMBERING

are operated by compressed air. The labor charged to the construction of one such chute, including miners, timbermen, mechanics, and miscellaneous, amounted to 900 shifts. The chute at No. 3 station on the 1900-ft. level is of special construction. On account of the blocky ground it was built of solid reinforced concrete, the stresses here being somewhat different from those required in supporting ground. Active development work was in progress on the 1900-ft. level at this time (early in 1919) and it was essential that the chute be constructed so as to interfere as little as possible with these operations. Accordingly, a false floor was put in at the station and the rock was broken from below until the bottom of the chute in the middle had been reached. This excavation was timbered to afford a new support for the station-floor, while space was cut at the sides for the walls of the chute. Old rail, pipe, and cables were used for reinforcement and the concrete for these walls was poured and allowed to set, after which they again assumed the burden of the false floor, while concrete for the floor of the chute and the bridge at the front was being poured. This bridge, six feet behind the shaft-timbers, extended from a point eight feet below the station-level to within two feet of the bottom of the chute, the lower part of the front being of 6-in. plank. Forms for the concrete floor of the station, which is also the top of the chute, were then built, the bottom and front being lined with steel plate. This job was completed without any appreciable delay in the regular mine work.

In opening a new level the procedure follows the regular methods of square-set stoping. A cross-cut is driven to the ore, drifts are started each way to expose the lode. Cross-cuts at irregular intervals determine the width of the orebody or the presence of branches on either side of the main vein. It may be remarked that under systematized development these cross-cuts are being placed so as to correspond with those on the level above, due reference being made to the size of the block to be mined. A raise in waste-rock is usually started off the second or third floor of a stope to provide, aside from ventilation, a passage for waste-filling. As soon as the drift has reached a point 300 or 400 ft. from the shaft a raise is started to make connection with the level above, and thus establish the circulation of air.

The first step in mining an ore-shoot is to remove the sill-floor, thus defining the probable limits of the shoot as it goes upward. Sill-set posts are placed at 6-ft. centres both girt-wise and cap-wise; these are 8 ft. 10 in. long; posts for the regular floors are 7 ft. 10 in. long. Round timbers are used exclusively, the diameter varying from 10 to 36 in., although the usual size is 12 to 14. No sills are laid, the posts resting directly on the rock. Recently it has been customary to drive the sill-floor only one set wide, opening the vein on the second floor, instead. This makes easier the work of keeping the sill open for tramming ore, waste, and timbers.

The next step is to build a chute-mouth and to start a two-compartment ore-chute and manway, which is raised as the stope advances upward. Two adjoining square-sets, properly situated with reference to haulage on the sill, are selected. The chute is 'bricked' in a fashion similar to the skip-chute mentioned previously. Blocks, 20 in. long, of round timber, are substituted for 12 by 12-in. square pieces, and layers of blocks are alternated with round timbers, 6 to 8 in. diameter, spiked between the posts. The wear is confined largely to the end of the bricking-blocks, and a chute so constructed requires the minimum of repair. The manway is lagged with plank. As stated, this chute is advanced floor by floor as the stope rises. A stope averaging four or five sets in width will generally require chutes at intervals of 50 ft., while a narrower one will not need as many in proportion to its length. Normally, after the third floor is reached, operations will require two sets of miners and timber-men, one at each end of the stope on the top floor, while shovelers will be working on the floor beneath. At the same time they will be filling the next lower floor with waste supplied from the level above through the chute-compartment of the original raise. Ordinarily temporary track is laid and a regular mine-car is used for distributing this waste. The character of the ground makes it imperative that the filling be not neglected; waste cross-cuts on stope-floors must sometimes be driven to obtain filling material. Especially on the lower levels, where the walls are not so good and the orebodies are fractured and faulted to a greater degree than above, particular attention is paid to keeping the filling advanced as far as possible. If, as sometimes happens, the pressure of a block of ground becomes too great and caving ensues, the recovery of the ore is a slow and costly operation. Skilled miners catch up the ground and subsequently remove the ore by underhand mining.

In spite of every precaution, there is continual difficulty in handling large stopes, 200 to 300 ft. long, and 20 to 40 ft. wide, when the entire shoot is mined as a single unit. The large horizontal area of open space frequently gives too much chance for shifting ground, so that trouble is averted with difficulty—if at all. Even though no cave results there is extra expense in angle-bracing and doubling-up timbers, and in building waste and timber bulkheads. In order to avoid this, the ore on the sill is blocked out by means of drifts and cross-cuts, after which successive sections of 50 or 60 ft. along the strike of the lode are mined. Each block includes the full width of the vein and is mined exactly as a separate stope according to the plan just outlined, except that the sets next ground yet to be stoped are lagged, before filling, so that no trouble is experienced with the subsequent removal of the adjacent block. This can be started as soon as the first stope has reached a height of six or seven sets. The great advantage is that a stope of this size can be run through from level to level rapidly, so that the overlying ground has little time to settle, and the amount of open ground on a horizontal plane is minimized. This procedure is in accord with the plan for the more orderly and deliberate mining that followed the rush of war-time activity, and it is working out with notable success. Down to 1900 ft. the levels are 100 ft. apart, but the next is at 2050 and hereafter the interval is to be 150 ft. This will effect economy by reducing by one-third the amount of drifting,

cross-cutting, and silling either on the first or second floors. However, it will increase the period required to mine a block of ore, and may prove disadvantageous on that account. In addition there is the possibility of overlooking small masses of ore between levels that might be found by more frequent cross-cutting. Detailed geological maps are kept up to date, however, so that this should be a minor drawback.

As can be seen from the map of the 1600-ft. level, a lateral—here in the foot, but on other levels in the hanging wall—is generally driven as a permanent haulageway to and from the stopes distant from the shaft. It is more economical to carry the laterals in waste rock and drive connecting cross-cuts at intervals, than to maintain the sill-drifts through the ore. The expense involved in replacing and repairing timbers, and otherwise keeping open the necessary workings, is indicated by the record of workmen daily engaged in this work, which regularly averages 80 men. This, at the present wage-rate, adds approximately 60c. per ton to the cost of mining, and, in fact, it is an unusually expensive item as compared with the cost of repairs in other districts or even other mines at Butte. It is due solely to the exceptionally heavy character of the ground.

The standard raise is a regular six-post two-compartment combination of chute and manway. It may be advanced vertically, or by an angle-offset, which may be in the direction either of the long or of the short dimension, in which case the chute must necessarily be beneath the ladder compartment. The sets are the same size as the ordinary square-set, so that there is no difficulty, in any case, in making the proper connection between the raise and stope timbers. A special cribbed raise, either vertical or on an incline, has certain advantages in that it is slightly cheaper, and requires less work to maintain in good condition. The timbers used are 5 by 10 in., laid skin-to-skin on the flat side. This type of timbering is desirable when the raise is to be used only for ventilation, as a passage for men, or for the transfer of supplies or waste. As a working raise for a stope it has the drawback of being difficult to tap to draw waste for the successive floors, and, especially if inclined, it renders difficult the task of standing the adjacent stope-timbers.

A phase of underground operations that is rapidly becoming of more importance is the work of the cement-gun, commonly termed 'guniting'. Briefly, the process is this: A dry mixture of portland cement and clean sand in the proportion of 1:3 is fed into the hopper of a machine, from which it is forced by pneumatic pressure through a large hose to the gun-nozzle where it is mixed with a regulated stream of water. The resulting plaster is 'shot' in a rapid stream against the wall or roof, where it adheres and soon 'sets' on the surface that is to be coated. The nozzle is manipulated by hand after the fashion of a fire-hose and any desired thickness from $\frac{1}{8}$ to $\frac{3}{4}$ inch can be applied in a single or in several successive coats. The surface may be a rough rocky wall from which any loose slabs have been removed, or timbers or planks that have been covered with some sort of metal-lathing. Ordinary fine-meshed wire poultry-netting serves well, although the regular metal lath is better. One of the particular advantages of 'gunite' is the protection to timbers against fire; it also preserves timber by excluding air. When applied to the rock itself, a coat of gunite prevents slaking and crumbling, and in so doing forestalls the loosening and slabbing-off of large pieces of rock. As an experiment, a cross-cut in waste, approximately 600 ft. long, was gunited without timbering; the cost was 35% greater than the cost of timbering would have been, but the expectation is that the walls and back will require virtually no attention whatever and that the extra cost will be much more than offset by saving in maintenance. In the Black Rock mine all the stations at the No. 2 and No. 3 shafts are gunited, as well as the connections between the two stations on each level. All fire-doors, of which there are several on each level, some of the motor-barns, underground pump-stations, water reservoirs, and other miscellaneous places are protected in similar fashion. The sand and cement are put through a concrete-mixer on the surface, and the dry material sacked for distribution underground. The work of running the machine is not agreeable and the operators are paid 50 cents per day above the regular rate. A willing man, after some experience, generally becomes quite expert at the work and the cost of a given job depends to a considerable extent on the number of new men who have tried their hands at the nozzle.

Haulage is done by electric locomotives of the storage-battery type; this style of motor was originally selected in preference to the trolley system. It is significant that in several of the neighboring mines of the Anaconda company where trolley locomotives have been in use, they are being replaced by the other kind. Aside from avoiding a constant source of danger the battery-motor system is more simple, more flexible, and more economical. Two batteries are provided for each motor and one is charging in the motor-barn while the other is in service. On the busy levels a re-charged battery is required each shift. The motor can handle a train of 10 to 12 loaded mine-cars on a fairly steep grade and with the assistance of a little sand on the track performs very well under conditions of severe service.

The placer camps throughout the Yukon valley, it is estimated, will yield $4,485,000 for the season of 1920. The dry season caused a decrease in the output of almost every camp. Hydraulic operations, consequently, have been much curtailed. Yields of the interior of Alaska and the Yukon for the season drawing to a close are estimated by competent authorities as follows: Dawson, $1,500,000; Fairbanks, $750,000; Tolovana, $750,000; Iditarod, $500,000; Tacotna and Ophir, $500,000; Hot Springs, $100,000; Ruby, $100,000; Koyukuk, $75,000; Circle, $70,000; Marshall, $50,000; Forty Mile, $50,000; Rampart, $20,000; Chandler, $20,000; total, $4,485,000. In commenting on this situation the Dawson 'Daily News' observes that, if the decrease in gold production continues, it will be necessary to restore the purchasing power of gold by bonus or otherwise as low-grade alluvial gravel cannot be worked under present conditions.

THE SALMON RIVER

THE PREMIER MINE

Notes on the Salmon River Mining District

By CHARLES E. PRIOR

The Salmon River mining district is in the Portland Canal mining division of north-western British Columbia. It is about 700 miles north of Vancouver and on the southern edge of Alaska. The district is three to six miles wide and 12 miles long, embracing an area of 60 square miles. The centre of the district is 16 miles from the dock at the town of Hyder, Alaska, situated at the head of the Portland Canal. The Stewart, or Bear River, district is immediately south.

The first mining activity in this region dates from 1898, with the arrival of Burgess and his party of 60 adventurers, at the head of the Portland Canal, in May of that year.[1] The purpose of this expedition was to locate gold-placer claims on the upper Nass river. These men, of whom only a few were bona-fide prospectors, lost heart after a fruitless search of a few months and gradually drifted back to civilization. However, some of the party, in wandering through the Bear and Salmon valleys, observed outcrops of quartz, containing metallic minerals. The news of these discoveries spread and attracted the attention of prospectors to this region, particularly to the Bear River district.

In 1904 the Big Missouri claim was staked, but not until 1910 was any real interest taken in the Salmon River district. At that time derelicts from the mining boom in the neighboring Bear River district wandered over the dividing ridge and were attracted by outcrops showing promising quantities of low-grade sulphide ore with occasional streaks and bunches of high-grade silver ore. A great part of the country was staked at this time, including the groups of the Hercules, Cascade Falls (now in the Premier group), the Indian, and the Bush.

[1] 'Portland Canal News', July 4, 1920.

From 1910 to 1917 considerable development work was done on these prospects, mainly in an effort to develop enough of the low-grade complex sulphide ore to merit exploitation on a larger scale. In 1917 R. K. Neill of Spokane, and associates, optioned the group of claims belonging to the Salmon Bear River Mining Co., which had been optioned and explored previously by several other parties. Under the direction of Mr. Neill, the upper or No. 1 adit-level on this property was advanced and in eight feet entered high-grade silver-gold ore. This was in September 1917. The subsequent shipment by Neill of 514 tons of ore, averaging $330 per ton, to the Tacoma smelter attracted the immediate attention of the outside mining world. In the fall of 1919 a working interest in this property, now the Premier Gold Mining Co., was acquired by the A. S. & R. Co. and associated interests. Since then shipment of ore, development of the mine, and the erection of a 100-ton flotation-cyanide mill have proceeded under the management of Dale L. Pitt.

The finding of a persistent shoot of high-grade ore in the Premier mine quickened interest in the various prospects of the district. Development work was started on the Big Missouri group by Sir Donald Mann and associates; on the Northern Light and Spider groups by the Algunican Development Co., a Belgian Corporation; on the Forty-Nine group by the Forty-Nine Mining Co., Ltd. of Vancouver; on the Unicorn group by J. R. McDonald; on the Indian group by the Indian Mining Co. of Prince Rupert, B. C.,—in fact, practically every showing in the district was explored. This exploration work was done by short adits, open-cuts, and, in depth, by the diamond-drill.

The boom expected in the summer of 1920 did not ma-

terialize, principally because wide publicity was given, and wisely so, to the fact that it was not a 'poor man's country' and that practically all the ground had been located. To the time of this writing, August 1920, the Premier is the only mine that has shipped any ore.

The climate of this coastal region of British Columbia is characterized by exceedingly heavy precipitation of both rain and snow, long but not severely cold winters, and short mild summers. Precipitation in the Salmon River district, 1919-'20, at an elevation of 2600 ft., averaged as follows: snowfall, 55 ft., rainfall, 30 in., or a combined precipitation for the year of approximately 100 inches of water.

The deep U-shaped valleys and the rounded mountain tops suggest at once erosion by glaciation. The lower valleys and slopes are densely timbered with spruce and hemlock. The upper valleys are occupied by glaciers. Elevations range from a few feet to 7000 ft. above sea-level.

Owing to the thick growth of timber and underbrush, the comparatively few exposures of rock, and the shortness of the summer season, prospecting is arduous and slow. Excessive transportation costs, adverse weather conditions, and uncertain migratory labor, are some of the hard conditions under which a pioneer operator in this district must endeavor to accomplish results. However, costs should be reasonable at a going mine and mill because an ample supply of water, plentiful and easily accessible timber, and the facilities for working mines by adit-levels are favorable to low costs.

Geologically, the Salmon River district is at the contact of the great batholith of grano-diorite, which forms the coast-range of British Columbia, and the volcanic and sedimentary rocks of the interior. It is an interesting fact that most of the important ore deposits of British Columbia are closely associated with this batholith of grano-diorite. The copper deposits of the Granby mine and the Britannia mine, the silver deposit of the Dolly Varden, and, in the interior, the gold deposit of the Hedley (Nickel Plate) mine and the copper deposit of the Canada Copper Coporation, are all in proximity to this grano-diorite intrusive.

R. G. McConnell's diagram[2] shows three principal formations in the Salmon River area: first, granite, grano-diorite, and quartz-porphyry; second, the Bear River formation, consisting of porphyrite, tuffs, breccias, and agglomerates; and third, the Nass River formation, consisting of argillite and tuffaceous sandstone. J. J. O'Neill[3] believes that the oldest rock series, tuffs and tuffaceous conglomerates, are overlain by the Nass series of gray shale and sandstone in the north-western and north-eastern parts, and have been intruded first, by the grano-diorite of the coast batholith, and second, by numerous dikes ranging from quartz-porphyry to augite-porphyry. The tuffs and breccias are found in a variety of colors—reds, grays, greens, and lavenders. This series predominates in the district. The Nass series of shale and sandstone occupies only a very small part of the district and evidently has played no part in the distribution of the ore. The porphyry and grano-porphyry dikes are the principal dikes of the district and vary from those of very fine-grained texture, which are with difficulty differentiated from some of the tuffs series, to the types containing large feldspar crystals and hornblende.

The quartz-porphyry is the principal ore-rock of the district. It is locally termed 'greenstone', by reason of its distinct green color. Orebodies are found in mineralized shear-zones in the porphyry; generally they lie close to the tuff. Regional shearing has developed these numerous shear-zones, the making of which was accompanied by silicification and pyritization of the greenstone itself. In many places the porphyry has been altered to gray and green schist. This schist greatly resembles that of the Britannia copper mine, although here usually the alteration has not been so complete as there.

The orebodies are in the form of lenses within the mineralized shear-zones. They are irregular in shape, having no well-defined walls or sharp limits between ore and waste. The ores of these deposits can be divided roughly into two classes: the high-grade quartz ore and the low-grade sulphide ore. There are no important oxidized ores in the district.

The sulphide ores are the more abundant. The metallic minerals in these ores are usually sphalerite, pyrite, galena, and small amounts of chalcopyrite, argentite, and native silver. The zinc-blende is usually the most abundant of the sulphides. Galena, in this district, carries little silver. A good example of these low-grade complex sulphide ores is found in the orebodies of the Big Missouri. The showing at this mine consists of huge surficial lenses of sulphide ore in altered greenstone. According to J. J. O'Neill,[3] the ore averages from $6 to $10 per ton. Three-fifths of this value is due to the zinc content, one-fifth to the lead, and one-fifth to the precious metals.

An analysis of typical high-grade ores of the district is as follows: silver 148.6 oz., gold 6.18 oz., copper 0.5%, lead 1.7%, zinc 3.3%, iron 7.6%, insoluble 75.1%, lime 1.3%, alumina 6.5%, and sulphur 8.6%. The metallic minerals usually present are argentite, pyrite, stephanite, pyrargyrite, native silver, tetrahedrite, sphalerite, and galena. Argentite is the chief silver mineral. The gangue is quartz and silicified greenstone.

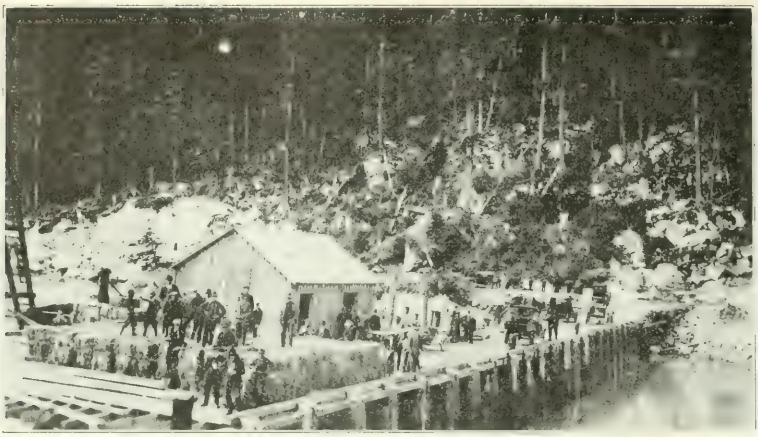
E. E. Campbell[4] believes that the high-grade ores of this district are entirely of secondary origin and that the oxidized portions of the outcropping orebodies have been removed by glaciation. Mr. O'Neill believes that the ores are of secondary origin and that the enrichment was produced by secondary mineralizing solutions entering re-opened fissures in the primary ore-zones. Victor Dolmage[5] recently made a comprehensive study of microphotographs of specimens from the district. He con-

[2]Canadian Geological Survey, Memoir 32.

[3]Summary Report 1919, Part B, Canadian Geological Survey.

[4]'Mining and Engineering Record', Vol. XXV.

[5]'Journal Canadian Mining Institute', June 1920.



THE LANDING AT HYDER

cludes that "the processes of secondary enrichment may have played only a very subordinate rôle, if any, in the formation of these rich silver deposits". Dr. Dolmage here means secondary enrichment by descending solutions. The principal high-grade ores of the district were unquestionably produced by enrichment of the primary ores by secondary mineralizing solutions, but not by descending solutions containing metal dissolved from overlying ores. A description of the Premier ores and their occurrence will explain this.

Quartz-porphyry dikes and bands of tuff are roughly parallel in the Premier mine and vicinity and have a general strike of S. 30° E. The individual porphyry dikes are as much as 1000 ft. wide, the individual bands of tuff up to 300 ft. in width. The tuffs are intruded by dikes of fine-grained hornblende-porphyry, which is probably the youngest rock in the district. Regional shearing has cut across both the porphyry dikes and the tuffs and has produced in the porphyry a mineralized shear-zone. This mineralized shear-zone bears N. 80° E., dips from 70° to 85° north, and is from 40 to 100 ft. wide.

The orebodies are found as irregular and ill-defined shoots within this highly silicified shear-zone in the greenstone. Pronounced cross fissuring at an angle of 45° to the main line of shearing has taken place. Masses of high-grade silver-gold ore have been formed at the intersections of these cross-fractures with the main shear-zone. This high-grade ore follows the hanging-wall side. The high-grade ore-shoots do not outcrop. Ore-shoots of milling-grade are in the foot-wall side of this shear-zone. In places, the ore follows the cross-fractures from the ore on the foot to the ore on the hanging wall. No displacement by faulting has been found.

The principal silver-bearing mineral is argentite, which is found both crystalline and amorphous. Ruby silver, native silver, and gray copper are the other silver-bearing minerals. The chief gold-bearing mineral is pyrite, of the [illegible] granular-loosely-knitted variety, the white large-cubed variety is generally barren. The gangue is quartz and silicified quartz-porphyry. When the price of silver is one dollar per ounce the ratio of the value of the gold varies from 1:1 to 1:6; the average for the shipping-ores is propably 1:2.5; the average for the milling-ore will show a proportion more nearly equal. The high-grade silver ore of the Premier mine was formed by the cross-fissuring re-opening the primary ore, and the subsequent entry of enriching solutions through these fissures and the precipitation of secondary minerals from these solutions in the primary ore. The milling-ore is probably primary ore that has been enriched to a small extent by the solutions that formed the high-grade ore.

S. J. Schofield, of the Canadian Geological Survey, is, at the time of writing, working out the structural geology of this district. The report of his results will probably be available within a year and will be of great assistance to operators in this district.

GOLD-BEARING BLACK SAND, such as that found on the beaches of Alaska, can be satisfactorily treated by amalgamation in a revolving barrel. Caustic soda should be used as an aid in this amalgamation. The use of cyanide during amalgamation or before amalgamation will result in a loss of 5 to 10% of the gold through its solvent action. If the quantity of sand is too great to amalgamate the entire amount, it may be concentrated by employing a classifier, whereby the bulk is reduced to approximately 40% of its original weight with very little loss of gold. The coarser portions of the sand, which is free from gold, should be removed from the classifier-feed. The water-supply should be constant, so that the upward stream in the sorting-column of the classifier does not vary from 35 ft. per minute. If much of the gold is very fine the classifier-overflow or tailing should be passed over a screen to separate the finer portion which may then be amalgamated in the revolving barrel.—U. S. Bureau of Mines, Reports of Investigations

The Ore Deposits of Mexico—VI

Ore Deposits in Surficial Flows of Igneous Rock

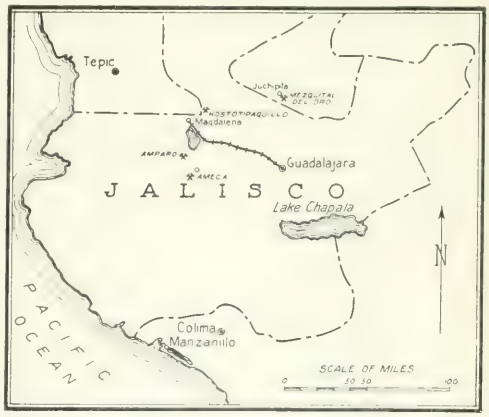
By S. J. LEWIS

We now pass to the second class of deposits in igneous rocks, namely, those found in the thick and extensive flows that have covered immense areas of southern Mexico. These ore deposits are correspondingly larger and more important commercially than those we have studied in the Zacualpan area. On account of the nature of the rock-masses and their chemical effect on ore deposition, it will be convenient to subdivide them into orebodies found in silicious rocks such as rhyolite; those found in rocks of an intermediate type, as andesite; and finally, those at the basic end of the series, as in basalt or andesite closely approximating basalt.

1. Igneous deposits in rhyolite: Mezquital del Oro. These gold mines in southern Zacatecas, close to the Jalisco border, are good examples of Tertiary gold deposits, presenting many of the typical features. The veins occur in an extensive flow of rhyolite, at least 500 m. thick. Later shale, similar to the Pleistocene shale of the not distant Ameca valley, overlie the flanks of the rhyolite sheet east of the deposits. Oxidation of the iron minerals in the rock has dyed the whole surface a bright red, which in the fresh rock is reduced to pale shades of pink. The Mezquital river has cut a tortuous and picturesque course through the flow, with canyon-walls as much as 300 m. high, and drains into the Lerma, or Santiago, river at the little village of San Cristobal, about 30 km. south of the mines. The river cuts squarely across the gold-bearing veins. The latter have been worked since before Spanish times in a crude way. As a whole, the deposits are low-grade and have not been profitable for many years.

The veins have been pretty well explored over a length of 1000 m. on the strike and to a depth in the principal shaft of 300 m. They are narrow quartz veins, parallel and close together, forming a gold-quartz lode that is typical of its class; it is irregular as to strike, dip, and distribution of mineral. The valuable metal is gold; the typical ore carries from 5 to 50 gm. gold per metric ton, with from 8 to 50 gm. in silver, which, of course, is negligible. Lead occurs rarely, principally in upper levels as fine silver-bearing galena, with a little copper as oxide and carbonate. All the bullion ever made at the mines, although of exceptional purity, shows a trace of copper. Manganese occurs sparingly as black oxide in dendritic crystals within minute fractures. The gold itself is invariably either in the form of minute scales scattered through the rhyolite, or in extremely beautiful leaves and fern-shaped crystals, deposited on quartz surfaces in the vein, in minute cracks or openings. Some of the specimens taken out of the quartz veins have been strikingly fine, with the fresh fern-like gold crystals powdering the surface of the quartz. The vein-filling is clean sugary quartz, frequently showing banding and comb-structure and sometimes quite high-grade; however, the principal mineralization occurs in the rhyolite wall-rock, due to an exceptionally thorough impregnation of the latter by hot solutions working outward from the channels, through the brecciated wall-rock and quartz stringers between the veins, and into the rhyolite. The quartz veins are from 30 cm. to a metre in width, but the enrichment of the wall-rock has frequently been so thorough as to make orebodies 8 to 12 m. wide and reaching from the lowest level to the surface.

Three well-defined stages are distinguishable in the



PART OF MEXICO

deposits; first, the general fracturing of the rhyolite sheet, due wholly to tension on cooling, and the formation thereby of the lode of quartz stringers, connected by innumerable small fractures running from one vein to another; second, the entrance of alkaline gold-bearing solutions into all the openings during a brief but intense recurrence of volcanic action, which solutions came from the heated depths of the mass and precipitated their gold when they reached the higher and consequently cooler portions of the fracture-zone. Lastly, the veins were heavily faulted by later movements across the axis of the lode, which faults have exercised an important influence on oxidation and enrichment.

In the first stage, there seem to have been two slightly-separated periods of tension, in the first of which the cooling fractures occurred in the shape of three closely asso-

ciated and nearly parallel cracks, that is, as a typical lode-fracture. A fourth crack followed approximately the same line of weakness, but soon diverged from the others, making a system in which the fourth fracture, dipping south, intersects the other three, dipping north. (Fig. 20.) This condition is visible over a length of about 500 m. The intense cracking and shattering of the rhyolite, with the mutually intersecting channels of all sizes, made a stockwork, peculiarly favorable for the formation of orebodies. The more important fractures form the sticks of a fan, opening out as the veins go toward the surface. The gold-bearing solutions rising to this zone filled the myriad cracks and channels, so that the rhyolite in the shattered zone adjoining the fractures was saturated with the hot solutions like a sponge. When change in chemical condition caused precipitation, the gold crystallized in place in all the shattered area. At certain points where conditions were especially favorable, pockets of rich ore were formed, so that the deposits are a succession of such pockets connected by the narrow quartz veins. There is no impoverishment on passing out of the lenses into the veins. The latter are frequently even richer; the difference is merely in the thickness of the ore. That the gold-bearing solutions were hot and not silicious is shown by the much-softened wall-rock, which has been highly altered, especially as regards the feldspars. Under the microscope it shows abundant flow-lines arranged in zones, with much intergrowth of quartz and feldspar. The larger orthoclase crystals are much decomposed. All the minute fractures and seams in the section are filled with scales of hematite. The two stages of alteration are therefore both indicated: the alteration of the feldspars by hot alkaline solutions, and the oxidation of the original iron sulphides that were doubtless associated with the gold in the primary solutions.

In the third, or enrichment, stage, strong fault-fractures cut across the lode at high angles, with a displacement of several metres where known, and with high enrichment on both sides of the faulting. There are three principal sets of displacements, in all of which the upper face of the movement seems to have received more enrichment than the lower. The great east fault at one end of the mines and the San Carlos fault at the other end have practically cut off development at their respective places; the one between, near the middle of the mine, was successfully passed, and systematic exploration would probably pick up the veins beyond the other two. That oxidation along the fault-planes has enriched the deposits seems certain, especially in pockets near the surface. The greatest pockets in the mine, however, seem to have been found at about 100 m. below surface, whence they went down on ore to the bottom, about 300 m. Below this level, the fractures, reduced to two fissures, go down with spotty mineralization, in which there is a tendency for the silver to increase in ratio to the gold.

The marked affinity of gold for silica could hardly be better illustrated than in this deposit. Rhyolite is the most acidic or silicious of the rocks; and although the magmatic solutions that saturated the ground doubtless carried other metallic minerals, only the gold, to all intents and purposes, came down from solution.

Even more interesting is the dissemination of the gold all through the shattered rock; we have here a fine illustration of reactions in a solid medium. The thorough shattering made the rhyolite an immense container holding vast quantities of the primary silicious mineral solutions; the later alkaline gold-bearing solutions diffused into the rock as they would into blotting-paper, reacting with the existing silicious solutions and depositing the gold in lenses or ore-shoots at irregular intervals in the structure, but grouped along the lode and separated by barren spaces. In a very definite way and on a great scale it is an example of the making of gold orebodies by the reactions discussed in the introduction to this part of our study.

2. Igneous ore deposits in intermediate andesites. The Hostotipaquillo district in north-western Jalisco (Fig. 21). Up to the present, the greatest silver producers of Mexico, and therefore of the world, have been in the Pachuca deposits of this type. They differ from those discussed principally in the extreme thickness of the igneous formation, and consequently in the depth to which fracturing and mineralization go down. The lodes of Pachuca are well known and have been profusely described. The veins of the 'Hosto' district, as, for brevity, it is usually called, have become of great importance as silver producers in the last ten years, and illustrate the same conditions very well without being so highly developed or so well known as those of Pachuca.

The silver lodes of the Hostotipaquillo district are in Tertiary lavas of intermediate chemical composition, being a series of andesite and rhyolite flows, bedded conformably on top of one another to a thickness of over a thousand metres. The important deposits are in the andesites. Considerable microscopic work has been done to show that the andesite assumes a dacitic phase now and then, but my own observations in the district have convinced me that such differences or variations in the rock have had little or no influence on the deposition of ore.

The cooling of these great masses, and the settling on their beds, have induced great fracture-systems, which, after mineralization have been extensively faulted. Such cross-faulting, both in plan and in strike, is an important feature of these deposits (Fig. 21). The effect of the faulting has varied with the conditions: there are many cases where the faulting has caused leaching of the silver mineral, especially in connection with brecciation; while there are others where the effect has been to make heavy enrichment.

Many of the mines were worked by the Spaniards, and, of course, were not sold in modern times to the present American owners until the orebodies were thought to be exhausted. Exploration in depth and beyond faulted areas has been fruitful; probably the most conspicuous example is Cinco Minas, the principal mine of the district.

Throughout this district the fractures are fairly regular in strike but show variation in dip, with a change of mineralization sometimes accompanying the variation.

The fractures are simpler than the Mezquital example, generally consisting of a principal channel and one or two smaller veins in one or the other wall, usually well mineralized. The fractures, however, are of immense size, the orebodies varying from a metre in width on the wall-stringers, to 8 or 10 m. wide on the principal channels. The veins consist entirely of silicious replacements of the brecciated andesite, cemented by massive quartz. The gangue-minerals are quartz, calcite, and rhodochrosite, the last being of considerable importance as an associate of the silver minerals, which are almost wholly finely divided argentite, with considerable native silver and

The distinguishing feature of the district is the occurrence of large areas of enrichment, usually as lenses, in veins of otherwise barren quartz. There are, besides, many large and well-marked veins in which no orebodies have ever been found. The highly complex faulting to which the veins were subjected after mineralization has brecciated great areas, and it is possible that silver leached from these areas has found its way to effect enrichment elsewhere. In Cinco Minas, a drift on the principal tunnel-level showed over 300 m. of shattered and leached quartz, with practically no silver, intervening between the greatest of the old orebodies and its San Juan neighbor.

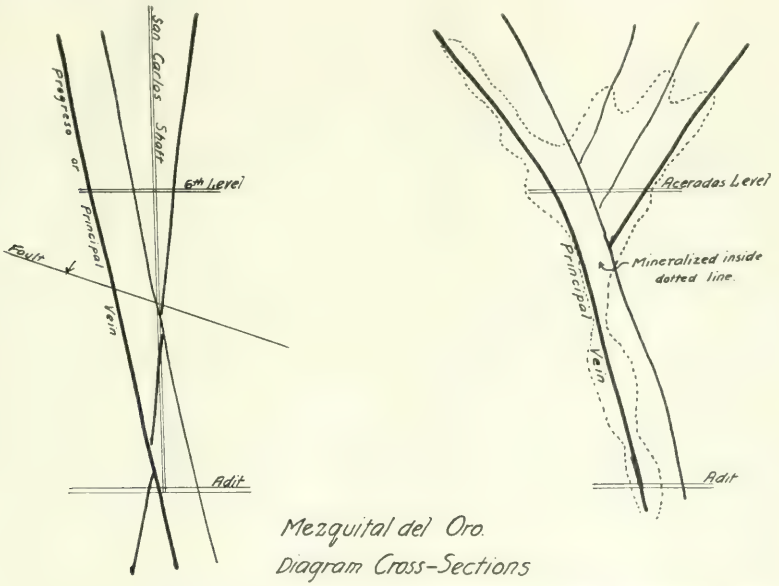


FIG. 20

occasional, rather rare antimonial combinations. The gold contents in general are not important, being about a gramme to the 'kilo' of silver. Lead, iron, copper, and zinc are present as sulphides, but not to a significant degree. That these base minerals were not precipitated at the same period as the noble metals is shown by the occurrence on the 200-ft. level of the Cinco Minas, in beginning the modern exploration in 1909, of lead ores that looked like rich silver-bearing lead ores found near the surface, but proved to be almost barren of silver. This condition was general for a zone intermediate between the bottom of the old orebodies and the beginning in depth of the new ones.

The manganese, frequently abundant as black oxide in a form that does not interfere with cyaniding, is yet in some of the mines a cause of metallurgical trouble, so that a few of the large orebodies of the district have up to date been unprofitable.

The orebodies at this and the other mines are chimneys of comparatively short length that go down as lenses succeeding each other to a great depth. Up to the present, profitable mineralization has been proved to 1600 ft. below the outcrop, I am informed.

The three stages of fracturing, mineralizing, and oxidizing, in these deposits, are strictly comparable to the same stages in the Mezquital deposits, with local differences of special interest, suggesting a comparison with the El Oro deposits. It seems likely that in the 'Hosto' deposits mineralization came in two separate periods: the first of primary nature, in which metallic base sulphides were deposited, with some silver, the gangue being predominantly calcite, though with some quartz, pyrolusite, and rhodochrosite; the second period came from wholly silicious solutions and probably added materially to the precious metal content of the ores. At a number of scattered mines in the district I have found excellent pseudo-

morphs of quartz after calcite, generally in connection with highly enriched ore. Perhaps a more interesting point of difference is the fact, already alluded to, that faulting in the district has destroyed ore deposits rather than enriched them. At Cinco Minas, step-faulting of a most interesting and complex character has in many places caused displacements in the enriched vein, of from three to six metres, shattered the quartz, and leached it. Similar occurrences of a similar kind are visible in the old San Domingo and Rayas veins on the Santiago river; in fact, it is a feature of the district. The effect in all cases has been to make long stretches of shattered and unprofitable vein-matter, separating important chimneys of practically pure silica enriched with silver sulphides. Surface agencies working on these chimneys under the fiercely oxidizing conditions of the climate, where the surface is alternately baked and chilled, or saturated and then dried to dust, in the manner characteristic of arid regions, have made oxidation an important factor in the formation of rich orebodies at the surface; in many cases these bonanzas have been followed down to intermediate depths with great profit. The limit of the very rich ore seems to be about 200 m. below the outcrop. Below that point the ore shows little secondary influence and is therefore lower in grade, although still profitable.

A curious feature of the extensive faulting and crushing of the veins here, has been the formation, in at least two cases that I have seen, of silver placer deposits from the débris. The destroyed vein, instead of being leached in place, as in other cases, has been rolled down into suitable hollows of the old surface, and pressed into vein-like masses by the weight of the accumulated washings from above. Such deposits, of course, have their value strictly limited by the ore measurable.

The formation of silver-bearing lenses in the quartz veins, in vertical or inclined zones having local constrictions and widenings, is strictly comparable with the formation of the gold chimneys in the Mezquital rhyolite. The fact that in the one case we have andesites of intermediate composition giving rise to silver precipitations, and in the other case we have acidic rocks giving rise to gold aggregates, certainly supports the view that the whole process is a chemical one, in which special conditions of precipitation result from the chemical effects of the wall-rock and the circulating solutions. The notable feature is the selective action of pure quartz or silica for gold, which will be seen to vary through the silver orebodies of the intermediate rocks down to the deposition of the baser metals in the rocks of the basaltic or basic extreme.

3. Igneous deposits in basic andesites or basaltic rocks. The Amparo mine, two hours ride from Etzatlan, in the State of Jalisco, is an excellent example of ore deposits in the least silicious eruptives. The rock is an augite-andesite, occurring in a mass of great thickness and Recent age. Strictly speaking, there is little difference in kind between this formation and those just discussed,

By permission of the Amparo Mining Company, and with acknowledgments to James H. Howard, general manager, Etzatlan, Jalisco.

as the Amparo rock-mass, while not a thin surface flow seems to be made up of a series of outpourings or thick extrusions, which made their way through the older formations and constitute the present surface. Flow-lines and abundant glass in the ground-mass are easily seen in thin sections of the rock, especially in the comparatively undecomposed rock of the Mesa Colorada, just above the mine and well away from the fracturing. This shows important differences from the wall-rock in the mine, and it thus seems possible that the mass was built up by successive flows of the same or similar material. In the mine-workings there is no evidence of stratification or separation of flows from the surface down to 1300 ft. in depth.

From Etzatlan, where the rock is of more intermediate character and where numerous occurrences of black obsidian are found, over to the Ameca district on the other side of the Amparo mine, is about 20 kilometres (Fig. 22). Here the same rock occurs as on the Mesa Colorada and it extends considerably to the west, its highest point being the mountain peak about 10 km. from the mine. The thickness of the mass is certainly not less than 1000 m. Its flanks are covered with recent rhyolite tuffs, deposited after the topography had been carved nearly into its present relations. There are no sediments nearer than the Pleistocene shales of the Ameca and Ahualulco valleys, 20 km. west.

The andesite is the ore-bearing rock of the district. It is generally greenish-gray where moderately oxidized; the rock of the near-by mesa is much darker, sometimes nearly black, and quite fresh in fracture. Where oxidation has been more thorough, the mine-rock is stained a purplish-red with iron oxides; epidote has developed sparingly.

Microscopic study of a series of Amparo rock specimens collected at more or less regular intervals of depth and at varying distances from the veins, has brought out some interesting facts bearing on the origin of mineralization. The dominant feldspar in most of the specimens is plagioclase, generally in well-shaped crystals, which show roughening and decay only where the ground has been much disturbed. With increase of depth, the prevailing feldspar gradually becomes orthoclase, as is shown in a series of sections beginning at the surface and going down to the 1300-ft. level. Some of the intermediate slides show the orthoclase crystals in process of zonary alteration to plagioclase.

The ferro-magnesian constituent of the rock is nearly always augite in a wide range of alteration from augite in bright clean crystals, sometimes beautifully twinned, through skeleton crystal boundaries with alteration to chlorite almost complete, down to masses and stains of chlorite with no trace of crystal forms. This is seen in slides made from specimens taken from parts of the ground where heavy movement and crushing have taken place during the period of vein-formation. In such ground, the iron is thoroughly oxidized to a red hematite, staining all the fine cracks in the rock; where there has been less movement, there is notably less hematite.

The typical augite andesite assumes a trachytic phase

locally at depth, at a point well removed from fracturing, but it returns in a short distance to the type rock, the local change having apparently had no important effect on the mineralization. At about the 700-ft. level the original unaltered rock seems to have been an augite-andesite with abundant large crystals of orthoclase and rod-like crystals of plagioclase in the ground-mass. Oxidation processes, whether working from the surface down-

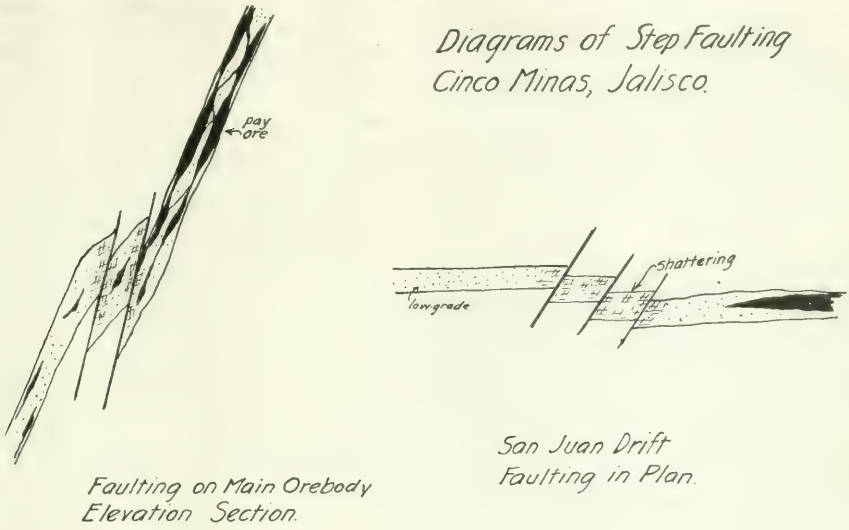


FIG. 21

orthoclase begins to appear in some quantity, increasing unmistakably with depth both in crushed and uncrushed rocks. The trachytic phase shows hornblende instead of augite. In all there is much secondary magnetite in small

ward into the mass or working outward from a fracture into the walls, have caused extensive alteration of the large orthoclases to plagioclase at the same time that the augite has altered to chlorite. The tension to which the

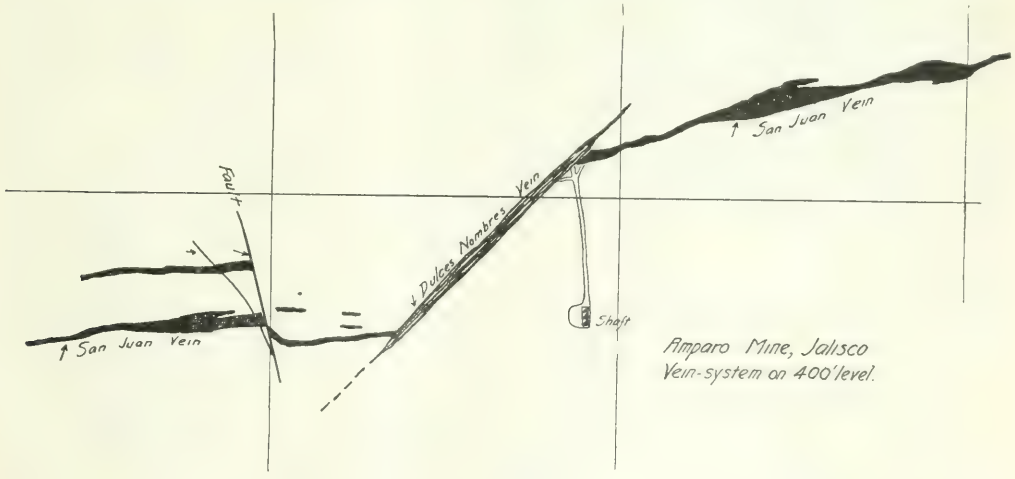


FIG. 22

rounded grains; secondary calcite and chalcedony are also plentiful in the minute seams.

The most significant alterations are noted in specimens taken from the near neighborhood of fractures. The rock has been subjected near the veins has crushed the large feldspars so that the rock from such points looks like tuff, with broken roughly-rounded grains of plagioclase and glass; a few metres away, in undisturbed

ground, it shows the crystals quite whole, though sometimes strained, and is easily recognizable as the typical andesite. Such crushing is especially common in specimens taken from levels which have been highly productive; that is, where movement of the ground has been most violent, crushing of the rock most severe. Where the vein suffers a local pinch and impoverishment, as on the 600-ft. level, the brecciation is not noticeable in thin section to any marked extent, and in general the rock looks fairly fresh. The evidence indicates that mineralization of the fractures and subsequent enrichment have been directly dependent on the ease with which circulation could take place; where fracturing has been heavy and thorough, we have enrichment; where the fracturing has been light and the channel is narrower and tighter, we have lack of enrichment.

There are few more interestingly complicated fracture-systems in the mines of Mexico than that of the Amparo mine; and it is this very complexity that is responsible for the enrichment, making effective the favorable chemical condition due to the interchange between the mineral solutions. One of the striking features is the presence of abundant manganese oxide in the form that does not interfere with cyanidation, from the surface down to the very lowest levels. It is quite well disseminated through the veins, and appears to have had considerable influence in carrying the gold down to the deep workings.

Three important stages of fracturing are distinguished in the mine:

A. The earliest movement is the San Juan lode, a strong fracture which in some places shows three well-defined parallel members. It cracked the ground in a general north and south direction, the result being a largely calcitic mineralization, introducing lead, zinc, iron, copper, etc., in small amounts, and abundant manganese. The dip of this lode is about 70° west (Fig. 22).

B. The next movement in point of time was the Dulces Nombres vein with its outlier, the Veta Verde, which latter has never been of commercial importance. The former cut through the San Juan cleanly in a northwest-southeast direction, displacing the separated sections by about 90 m. This stretch of nearly 300 ft. along the Dulces Nombres vein, joining the two pieces of the San Juan, became much enriched as a result of the dragging of the ground and the re-opening of the channels. The brecciated wall-rock and the gangue-minerals already existing in the fractures of the San Juan, became favorable points for deposition, and the Dulces Nombres lens became a short but deep chimney of well-mineralized ground. A marked difference is noted in the character of the second mineralization: whereas the first was markedly calcitic, the second is markedly silicious. This can be observed in the Veta Verde, which on account of its position on the extreme edge of the disturbed ground, did not participate in the re-opening of the channels to an equal extent with the other veins. Its mineralization is notably strong in calcite, generally in fine crystals formed in open cavities and based on the vein walls; silica is not nearly so abundant as in the other veins, and the vein has not been profitable except in a few scattered spots. In the San Juan veins, pseudomorphs of quartz after calcite have been found down to the deep levels; the calcite persists also, so that on the deepest level the calcite and quartz are about equally represented. The freshly circulating silicious solutions doubtless exercised an enriching influence on the primary calcite deposition as regards gaining in silver and gold; in which respect the mine is another example of the enrichment by later silicious solutions, as at El Oro.

The dip of the Dulces Nombres fracture is about 70° east, that is, directly opposite to that of the San Juan.

C. The great fault-movement that cut the San Juan vein in the south was the latest and from an economic standpoint was the most important of the whole series of movements. The result apparently of settling of the whole upper portion of the mountain, it cuts across the southern half of the San Juan lode at a high angle, and dips about 60° north, displacing the veins about 10 m. to the east. The repeated up-and-down movement incident to such an important fracture ground up the rock-breccia into the finest particles of impalpable clay, and the gouge thus formed in the fault zone, from 30 cm. to a metre thick, acted as a check to circulation across the San Juan channels. The precipitation thus induced caused heavy ore deposition on both sides of the fault. The exploitation of the southern part of the mine has therefore taken the form of mining two separate, extensive, well-mineralized bodies; the first-known and lesser, on the upper side of the fault, terminating against the face of the displacement; the later-discovered and much larger body on the lower side of the fault, beginning practically at the surface of the displacement and going down practically without reduction of width or values about 1000 ft. Both bodies owe their commercial importance in large part, if not wholly, to the accidental interruption of the circulation and the resulting precipitation against the dam.

The ore is a silver-gold mixture, with the value of the minerals about evenly divided, the mill ore running about 8 gm. of gold with 300 gm. of silver.[20] The latter occurs principally as argentite with oxidation products. The gold is seldom or never visible either to the eye or the hand-glass. A good deal of brecciated and altered wall-rock occurs in various stages of replacement. Manganese has been already mentioned as very abundant from top to bottom of the mine, both as the black oxide and as the pink carbonate, rhodochrosite. The latter is probably more in evidence at the deep levels than the oxide. In depth the gold contents show no such sudden decrease as would occur in a Tertiary deposit lacking the manganese. They persist with great uniformity down to the deep levels, suggesting that the reactions necessary to carry gold down in iron solutions were undoubtedly greatly assisted by the presence of the manganese.[21]

[20]With silver at 1912 prices. Of course, the ratio is changed now.

[21]W. F. Emmons, 'The Influence of Manganese in the Deposition of Gold Ores', Trans. A. I. M. E., Vol. LVIII, p. 232.

In studying this important ore deposit, one is struck at once by the great part that has been played in it by intensity of fracturing; when, however, the nature of the resulting mineralizations is compared with that of the other deposits in eruptive formations that we have been discussing, like the Mezquital rhyolite and the Hostotipaquillo andesite, the most striking feature of the comparison becomes the difference in mineralization as related to the difference in acidity of the wall-rocks. Mezquital, a mine showing thorough fracturing in a highly silicious mass, is a gold mine pure and simple, with hardly a trace of any other metal. Cinco Minas, in andesite of practically neutral composition but with a vein-system showing almost as complex fracturing as the other examples, is distinctly a silver mine, with practically nothing of other metals. Both classes of deposits show quartz vein-fillings with but little replacement of the wall-rock and with very small quantities of sulphides of the base metals. At Amparo, on the other hand, we have mines in andesite of the least silicious kind, carrying the most feldspar and iron minerals. Here, the result of mineralization is predominantly a deposit of sulphides of the base metals, lead, iron, and manganese in abundance, zinc and copper more sparingly, but the whole being emphatically a base-metal mine, with the silver and gold as mere traces, quantitatively speaking, although, of course, they are what give value to the mine. Putting it in another way, the deposits in rhyolite and neutral andesite present no metallurgical problem, except, of course, in the case of manganese silver ore. They are combinations of silver or gold with a quartz and calcite gangue, and the separation is not difficult; whereas in the Amparo the combination has been not only with the gangue-minerals, but with sulphides of all the base metals, requiring a high order of metallurgical skill for the separation.

The alkalinity of the wall-rocks clearly is a factor of great importance in determining what minerals shall be precipitated out of the circulating solutions. This is supported by our review of deposits in sedimentary rocks, which shows that mines in alkaline masses, like the limestones, are predominantly base-metal mines; whereas mines in the less alkaline rocks, like the eruptives, are pre-eminently deposits of the noble metals. If we review all our examples, we find that where the rock formation is highly silicious, but the mineral solutions were unmistakably alkaline, we get gold deposits with hardly a trace of other metals. Where the rock formation is intermediate or neutral and the mineralizing solutions at the most important stages were silicious, we get silver deposits, with the base metals still insignificant, though of more importance than in the former class; and finally, where the rock formation is least silicious or fairly alkaline, the general final result is the deposition of base metals, with such gold and silver as may have been brought in during periods of varying alkalinity in the circulating solutions. This is true from the operating point of view also, despite the fact that the few hundred grammes of silver accompanying lead deposits in limestones may mean a considerable profit, or the fact that many of the great silver mines carry very appreciable quantities of lead and zinc.

Further proof of this relation is afforded by a brief glance at a typical copper camp in eruptives, like the Ameca district not far from Amparo. The condition there is complicated, however, by the presence of later eruptives intruding the formation.

The predominating rock in the Ameca copper district is a dark heavy basic andesite, even more alkaline than the Amparo rock, and sometimes closely approaching the basalts. Under the microscope it shows a dense groundmass of plagioclase feldspars, in brilliant clean-cut rod-like crystals. The ferro-magnesian constituent is hornblende or hypersthene, and there is a great deal of primary pyrite in the rock, frequently visible to the naked eye. There are two classes of copper deposits in the district, owing their origin to the two kinds of rock intruding the andesites; first, the contact bodies, irregular in shape and tenor, occurring on the contact of a monzonite-granite intrusive with the andesite; and second, true vein deposits, occurring near porphyritic dikes of small thickness and nearly vertical in dip. The first class is exemplified in the Almoloya deposit, a little higher up the range than the similar Las Moras deposit. In both, the

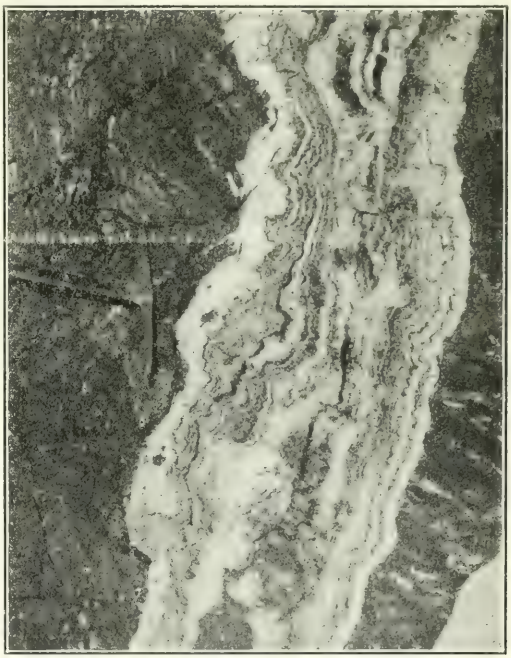


FIG. 23. PHOTOGRAPH OF ESPERANZA VEIN, AT EL ORO*

*By courtesy of Charles Hoyle, manager for the Esperanza Mining Co., El Oro, and of T. A. Rickard. See also U. S. Geol. Sur. Professional Paper No. 68, plate 3, for a fine example of ribbon structure.

monzonite underlies the andesite and outcrops as a stock near the former mine. The granite shows the characteristic deep striations of the plagioclase crystals, visible without a glass. The west slope of the stock is covered by the andesite, and the contact has mineralized to an interesting extent with copper sulphides, practically to the exclusion of the other metals. It will be remembered that similar monzonite intrusions into limestone in the Coalcoman country have already been cited as producing copper and iron.

The second class is best exemplified in the Magistral, the most important mine of the district. Here the best orebody occurred at the coming together of the two principal fractures, near the porphyry dikes. In all the known veins, the orebodies are of short length and go down in chimneys to the depth so far explored, about 200 m. below the outcrop. In the contact deposits, the usual secondary-silicate minerals are found abundantly, with a great deal of replacement of the brecciated rock. Three-cornered pieces of rock, completely altered to chalcopyrite, are found in calcite gangue. The copper veins are similar, especially as regards replacement, which is really the distinguishing feature of the district. In all cases, copper is the sole recoverable mineral, the silver being almost negligible and the gold wholly so. There is the usual surface oxidation of the copper sulphides to carbonates and oxides. The gangue is hard and silicious, involving much sliming of the mineral.

The Santa Maria antimony deposits described in Part II of these articles, in which a base metal has been precipitated on a contact of two quite basic rocks, without a trace of the noble metals, will be recalled as another example of the influence of the wall-rock in determining the nature of ore deposition.

Conclusion. The practical object of the study of orebodies, is to enable us to find ore; and while chance certainly plays its part in the finding of precipitations that were determined more or less by chance, a knowledge of the habits of orebodies in a given district or in many districts is the best possible equipment for the miner.

In all that part of Mexico which from Spanish times has been known to possess silver-bearing veins, prospecting has been so thorough that in the vast majority of cases, the good mines of a district are well known, and the proportion of good strikes in prospecting for new mines is very small. This is not true of the lead districts of northern Mexico, simply because the Spaniards had not much use for the lead; however, there are comparatively few even of these lead mines that were not worked in ancient times.

The idea has been advanced in the foregoing pages that ore deposition is simply a record of a chemical interchange or series of interchanges, which has taken place in huge containers formed by fracturing of the earth's rocky crust. In searching for new orebodies, we search for a place where chemical conditions were favorable for precipitation; the surest way to find such a place, at least in Mexico, is to search in a locality where such precipitation has already been known to take place. That is, there is considerably more chance of finding ore in new bodies in an old mine, than there is of developing profitable ore in a new prospect.

It should go without saying, that this statement is limited by the geological structure in which a given ore deposit occurs; there are many Mexican *antiguas* where only brief study is required to show that enrichment is not likely to continue to any reasonable depth, and exploration on old orebodies would therefore not be justified; in such a case, the winning of a profit would be dependent on the finding of new shallow orebodies near the surface. In the majority of cases, however, where the veins occur in thick rock-masses under the conditions of climate that we have in Mexico, exploration in depth, or beyond fault-planes, in old mines, may be expected to yield a high rate of success. In all cases, success depends on a cultivated faculty of observation, in which no detail is too insignificant, and which patiently and surely gathers a multitude of facts for correlation and study. With such a faculty, and with the intellectual honesty that causes the observer to accept a fact the moment it is observed, no matter how disturbing it may be to theories already formed, the finding of new orebodies in Mexican mines is accompanied by much less uncertainty than is prospecting for new deposits.

From the minute local peculiarities with which the miner has to deal and which mean for him either success or failure, it is a far cry to the cosmic viewpoint of the geologist who reviews the whole process of ore deposition from its beginning to the present day; yet it may be of interest to point out two facts that are often lost sight of: the limits of time and place in ore deposition. First, we note that nearly all the workable ore deposits of the country were begun and brought to their present state in a period that geologically is of the shortest; for the few hundred thousand years that make up Tertiary time is as nothing compared to the millions of years of which the globe shows a record. The whole process of deposition of metallic minerals and their re-working into pay-ore has been accomplished in a few geologic moments.*

Secondly, all the profitable ore deposits of Mexico are found in a thin skin of surface material approximately 2000 ft. in depth; less than half a mile or roughly one-twenty-thousandth part of the earth's diameter. Geologically speaking, therefore, ore deposition in Mexico is most emphatically a surficial operation; and from a broad point of view, the whole series of operations, primary deposition, recurrent movement of the walls, re-deposition and enrichment, is made up of chemical processes, chiefly oxidizing, which take place wholly in the extreme outer skin of the earth, practically in permanent contact with oxidation influences.

If we conceive of a ball 20,000 ft. in diameter; that is, nearly as high as the highest mountain on earth; then the thickness of one foot on the surface of this ball represents closely the relation of the thickness of the ore-horizon to the whole mass of the globe.

*This point has been emphasized by T. A. Rickard, 'Persistence of Ore in Depth'. Trans. Inst. M. & M., London. Vol. XXIV, p. 36.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

FREIGHT ON BULLION SHIPMENTS REDUCED.

Bullion rates on shipments from Arizona smelters have dropped $2 per ton, it was announced last week by the traffic departments of the Southern Pacific and Arizona Eastern railroads. The rates apply only to shipments on Morgan line ships to New York and Eastern ports, via Galveston. The all-railroad rate is $22.10. By Morgan Line Southern Pacific steamship the rate is $20 per ton.

TUCSON.—The main orebody of the old Yuma mine, 14 miles north-west of Tucson, that had been lost on the 200-ft. level, has been re-discovered on the 300-ft. level in a cross-cut into the foot-wall from the shaft. This cross-cut is being continued; the ore is exposed to a width of 5 ft., an average sample assaying in lead, copper, gold, and silver, $82.50 per ton. The main lode is from 12 to 20 ft. in width, and developed by open-cuts and shaft for a distance of 4500 ft. The Yuma is a famous old mine, located in 1872. Equipment consists of a 200-ton concentrating-mill, mining-machinery, electric-light system, store, and dwelling-houses.

MIAMI.—Seven thousand five hundred pounds of 20% T.N.T. was exploded on September 29 on the new Superior highway, to dislodge about 8000 yd. of rock that tumbled from the side of the mountain down into the canyon. The old Cowboy property, known as the McGraw gold mine, has been sold to a syndicate of Michigan men for $60,000 and one-half of the ore now on the dump.

PEARCE.—The 150-ton mill on the Middlemarch property, near Pearce, has been temporarily shut down on account of shortage of water. Work is now under way to develop more water. After exhaustive tests, a method has been perfected for separating zinc from copper concentrates by flotation.

GLOBE.—A suit for damages, amounting to $35,000, has been filed in the superior court at Globe by Mrs. Clyde M. Ney, widow of Clyde M. Ney, former employee of the Old Dominion Copper Co. At the time of his death, Mr. Ney was an engineer in the service of this company, and while working on the 1800-ft. level was killed as the result of a blast in a working place which he had entered. At a coroner's inquest the following day, no responsibility for the death was fixed.

BISBEE-WARREN DISTRICT.—Thirty thousand dollars in gold coin was paid out on September 21 by the Bank of Bisbee to miners of the Copper Queen Co., this being the first pay-day in three years that the miners received their pay in the yellow metal instead of by a piece of paper. A serious shortage of fuel threatens the Warren district and has resulted in the shutting down of the Boras and Nighthawk leasing companies, the Higgins Mining Co., and the Denn mill. All these companies are dependent for power on the Bisbee Improvement Co. which has been forced to cut their power to conserve fuel for the city lights and gas plant. Relief of the shortage depends on transportation. The bigger mining companies are not worried by the shortage. Fuel-oil used in the Warren district, at present, is being shipped by boat from Mexico to Galveston, and it is feared the Gulf storms may further delay shipments. All records for speed were broken in sinking the new ventilation shaft in the Briggs division of the Calumet & Arizona property. The total depth of the shaft, to be known as the Oakland, is 827 ft. The best advance was made during August when the shaft was sunk 281.5 ft. The object of this new shaft is to remove all smoke and gases from the large sulphide area in the Briggs division. During the latter part of March of this year, a fire broke out in the stoping area, between the 1300 and 1400-ft. levels. This was temporarily extinguished, but a month later broke out again, and the management decided to sink the new ventilating shaft, to avoid a repetition of these outbreaks. Operations of the Western Ore Purchasing Co. of Utah and Nevada, purchasers and samplers of ores direct from the prospectors, will, it is said, be extended to Arizona within sixty days by the erection of two plants of 4000 tons per month capacity, one of which will be at Tucson and the other at Douglas.

PATAGONIA.—The Blue Nose has just completed the delivery of a carload of carbonate ore. The Flux mine is working at the 260-ft. level in a vein of milling-ore 25 ft. wide.

JEROME DISTRICT.—Recently an ore-chute between the 1350 and 1200-ft. levels at the United Verde mine caught fire from the blast of an explosion. The fire was not of great extent, but for a short time the smoke was oppressive and threatened to overcome the men who rushed down from the change-room and extinguished the flames before any considerable damage was done. The Western Chemical Co. has commenced operations at the sodium sulphide deposit. It is reported that dynamite has been found unsatisfactory as an agency for loosening the sulphate and therefore all blasting will be done with black powder. Haulage will probably be done by contract and approximately ten 5-ton machines will be needed.

COLORADO

RICH ORE IN THE MAYBELLE.

Cripple Creek.—Drilling has been resumed at the formation test in the north end of the district, the bit having been recovered by reaming. The test is now below the 2000-ft. point and important developments are expected in the next few days. The core showed nothing but Pike's Peak granite to a depth of 1084 ft., at which point the drill passed into heavily mineralized rock showing pyrite and fluorite. This continued for 16 ft. At 1100 ft. granite was again found but pyrite was present. At 1196 ft. the drill dropped 5 ft. into an open crevice. Water used for drilling disappeared. The hole was cemented back for 20 ft. and when drilling was resumed the bit fitchered and this caused the long delay. The Gold Bond property, on the south-eastern slope of Gold hill, has been leased. An air-line has been connected to the compressor at the Dig Gold company's shaft on the Alpha & Omega nearby and development is progressing. Tetrahedrite containing a large amount of silver is reported by lessees at the Blue Flag mine, Bull hill, owned by the Buckeye Mining Co.

Silverton.—Rich ore has been found at the Maybelle mine in Poughkeepsie gulch, idle 20 years. The property, owned by Mrs. Charles Carlstrom of Silverton, is under lease to Fred Jacobs of Red Mountain, who last week shipped a car of gold-silver ore estimated at better than $500 per ton. Mines are working short handed on account of claim owners, having unpatented properties, leaving to perform assessment work.

Leadville.—A compressor and other equipment is being installed at the Bard, Wall Street, and Gnome properties for Fred Johnson and associate lessees. Both Wall Street and Gnome already produce oxide ores, lead sulphates, and gold ore.

Camp Bird.—From quarterly reports of the Camp Bird, Ltd., to June 30 it appears that the eastern workings have not so far revealed other than short stretches of commercial ore. Work in this direction has, therefore, been suspended and all activities transferred to the west end, working from the tunnel-level. The vein carries all the characteristics except that to date it has been very lean.

MICHIGAN

POWDERED COAL FIRING IS BEING ADOPTED AT CALUMET.

Calumet.—The Stanton mines, Wolverine and Mohawk, are sold well ahead and a market could be found readily for a greater output if the men were available. In fact, were it possible to obtain miners and trammers in sufficient numbers, the mines would be operated to capacity. In this connection, the arrival of Italian immigrants at Mohawk is encouraging. More are expected. The coal situation no longer appears to be troubling these properties. Notwithstanding the oft predicted end of Wolverine, the mine goes along producing copper and while the yield and output become smaller each year the actual end of the property is far distant, even if operations are conducted on no other than the Kearsarge amygdaloid. A number of the workings in the upper levels will yield considerable quantities of metal before the shaft pillars are removed for there are long stretches of ground that have only been touched, so far as stoping is concerned. On the 14th level there is a block of ground 700 ft. long, between No. 3 and No. 1 shafts, that has been opened little more than by a drift. On other upper levels there are similar stretches in reserve. Operations at present are confined to lower levels, and a long time will elapse before it will be necessary to begin removing the ground in the upper openings. By that time it is expected that conditions will have improved sufficiently to warrant the exploration of ground east and west of the amygdaloid formation.

Mining men here attach considerable importance to the mechanical tramming-devices and scrapers in Calumet & Hecla conglomerate-shafts and there is a hope that the greater part of the difficulties that have arisen in past years from the shortage of trammers will be eliminated. Only three of the shovels are in use but there is a likelihood that they will be installed throughout the mine. It is stated unofficially that the device has measured up to the most sanguine expectations and that a complete equipment of them would enable the company to make a material increase in production with the present force of miners. Three men operating a shovel can do as much work as eight men by hand shoveling.

Steel is expected to arrive for Calumet & Hecla's new flotation-unit within two weeks, but uncertainties in delivery may prevent the completion of the work before spring. At the Tamarack reclamation plant, preliminary work is under way. The old structures have been dismantled and the machinery removed. The concrete foundations for the new buildings and machinery will be put in this fall so it will be possible to erect the tanks, tables, and grinding-machines by spring if the manufacturers can make delivery. This plant will be more than half as large as that of the Calumet & Hecla.

The Michigan smelter has started driving piles for the foundation of a new building. The new structure is to house a coal-grinding plant and is being built to supply the coal dust burners at the smelter furnaces. The coal-dust firing system is new to the Michigan copper country although it has been used in Western smelters with much success. The machinery for the plant has been ordered but it is not likely that the new system, which will work a considerable saving, can be completed and in working order before spring. The 13th level drift at Gratiot, 826 ft. from the shaft, is rapidly approaching the Mohawk No. 1 shaft boundary. The ground is described as satisfactory and stretches of it have revealed even higher value than was opened in the Seneca. The showing bears out predictions of mining men that have been in touch with Mohawk, that the best ground would be opened near the northern boundary of Mohawk. The fifth level plat at Seneca is practically complete and preparations are being made to proceed with the concreting of the shaft and the laying of the skip rails. When these pre-

liminaries are finished drifting will be begun. The best showing in the shaft at present is in the third level north, which has reached a length of 710 ft. from the shaft. The ore on the fourth level, 630 ft. from the shaft, is fair. In the fourth level south about 10 ft. from the Ahmeek boundary, the quality is poor. This drift is 376 ft. from the shaft.

Hancock is building a concrete reservoir on the 53rd level to prevent the water from overflowing into the new openings. If the price of coal continues high it may be decided to suspend pumping and the concrete dam will take care of the water until operations are resumed. In some quarters it is rumored that Hancock will dispose of its holdings to Quincy, but there is no confirmation of the report.

Superior reports a slight increase in tonnage for September, with a total of 1700 tons to date. This ore is coming from exploratory openings in No. 1 shaft, chiefly from the elevation of the 31st level. The best ground in this shaft was opened 700 ft. south on the 31st level, nearly a half mile from the shaft.

Ahmeek's tonnage shows a steady improvement with daily shipments of nearly 3000 tons. This is the best that has been reported for nearly a year and if more miners were available it would be possible to make further increases. Kearsarge reports a slightly smaller daily average, 1500 tons, while Osceola's daily tonnage has dropped to 250.

NEVADA

A SELECTIVE-FLOTATION MILL WILL BE BUILT AT THE SIMON SILVER-LEAD MINE.

Divide.—It is reported that the vein cut recently on the 700-ft. level of the Gold Zone assays $40 for a width of 25 ft. and that 10 ft. of this width assays $150 in gold, according to mine-car samples. The station on the 1000-ft. level of the Tonopah Divide has been timbered and the sump is nearly completed. The Kernick shaft has passed the 900-ft. point.

Virginia City.—During last week 166 tons of ore assaying $17.80 was mined in the winze being sunk from the 2150-ft. level of the Consolidated Virginia. The ore has raked out of the winze, but a drift from the bottom has entered the shoot. During the week 400 tons of $22.50 ore was produced from all parts of the mine. The Gold Hill miners are still on strike.

Tule Canyon.—A drift being driven west on the 200-ft. level of the Silver Hills is expected to enter the ore-shoot within 10 ft. The company has again changed superintendents and Edward Orr, formerly with the Goldfield Consolidated, is now in charge. This change followed rumors of unnecessarily high operating-cost. The Silver Hills and a company driving a tunnel several miles north of the Ingalls are doing the only work in the canyon.

Cactus.—A carload of ore assaying $75 to $100 has been shipped by the Cactus Nevada to the Development mill at Goldfield. The force of miners has been reduced due to difficulty the company is having in raising money.

SIMON SILVER-LEAD MINE, NEVADA

Rand.—The Gold Pen company, which several months ago started milling ore in a 20-ton plant, after statements published in Nevada newspapers had announced important high-grade orebodies in the mine, is now being sued by machinery and mercantile companies. The district boomed early in this year on the strength of reports from the Gold Pen, Nevada Rand, and Mimms. The first was said at that time to contain, among other orebodies, one in which there was 400 tons of $500 ore.

Tonopah.—The Tonopah Mining Co. has stopped work in the Blue River placer field in Colorado and the project has been abandoned. A five-sixths interest was acquired eight years ago for $375,000, but the venture has proved unprofitable since 1915.

Como.—A clean-up is being made at the 100-ton mill of the Como and when this has been completed the mine and mill will be closed for the winter. The Como is a silver-gold mine that has been producing at a rate of $200,000 yearly and the reason given by Gurney Gordon,

manager, for the closing is the high cost of supplies and a scarcity of miners. The mill has been treating $12 ore with a recovery of 98% of the gold and 90% of the silver.

EUREKA.—The stockholders of the Eureka Croesus, at the annual meeting held in Eureka, voted to increase the capitalization from $1,500,000 to $3,000,000. The annual report is to be issued in a few days.

ARROWHEAD.—The Arrowhead continues to ship to Tonopah at a rate of 75 tons per month. The ore assays $100 to $125 per ton. The company is planning to increase the output to 100 tons monthly by using another truck and improving the road to Tonopah.

GOLDFIELD.—The Grandma has levied assessment No. 7, at the rate of 1c. per share, delinquent November 1. The shaft, which is being sunk from 830 ft., is now 870 ft. deep and it is expected that at 1000 ft. a cross-cut will be driven to the east-dipping shaft, although the depth at which the cross-cut will be driven will depend on the depth at which favorable conditions are found in the shaft. The company has arranged to secure a lease on a part of the Kewanas, adjoining the Grandma on the west, so that prospecting for the shale-latite contact may be continued into the Kewanas if it is not found in the Grandma claim. The winze sunk on the west-dipping shale at 815 ft. exposed ore assaying as high as $17.50 and from a raise near the winze assays of $40 were secured. The winze was sunk 75 ft. and at this depth the company drifted 125 ft. west. All of this work showed the latite and shale to be highly metamorphosed and the ore was found erratic in width and value. The west-dipping shale also will be explored at greater depth. The winze from the 910-ft. level of the Spearhead has been sunk 250 ft. The vein, 8 ft. wide at this depth, is low-grade. The vein walls have been alaskite since sinking was started and the winze may be continued to 750 or 1000 ft. The Development mill will be closed for the winter and preparations are being made for the final clean-up. The last shipment was made to the mill on September 29. John P. Sweeney has secured in the district court a judgment against the Conqueror Consolidated Mining Co. for $5411.50, alleged to be due for salary as manager and for money expended. The Conqueror, owning ground in the northern part of the district, has been inactive for years.

MINA.—Mill construction will begin shortly at the Simon Silver-Lead mine, 22 miles east of this town. The mill-site selected lies on the west slope of a steep ridge, across a deep gulch from the present 565-ft. incline shaft and south of the site of the main three-compartment shaft. Ore will be delivered by gravity from both shafts to the mill storage-bins. The ore contains silver, lead, and zinc; the process to be employed is selective flotation; by regulating the oil-feed in the cells, separate lead-silver and zinc-silver concentrates will be produced. After crushing, the oversize from a trommel passes through rolls to a Hardinge ball-mill and then to a Dorr classifier, the coarse going to a small ball-mill and then returning to the classifier. The pulp then passes to a series of 26 flotation-cells of the Minerals Separation type. Here, by the use of cleaner-cells and re-floating the product from certain cells, the separation of lead and zinc is effected and the lead-silver and zinc-silver concentrates pass to separate units of the filter plant. Semi-Diesel engines, generating 250 hp., will supply power for the mill. It is said that this process ensures a zinc recovery worth $3.50 per ton and that it will convert the usual penalty on this metal into an important revenue. Development in the mine has progressed to the seventh level, at a vertical depth of 565 ft. Carbonate ore, some of exceedingly high grade, was found on upper levels and sulphide ore appeared at 200 ft., but the sulphide level is placed at 230 ft., for purposes of estimating reserves. Before ore had been found beyond the east and west faults, the company's engineers estimated 400,000 tons between 230 and 400 ft. depth, that would net $7 per ton.

PIOCHE.—The Nevada Horn Silver property, 23 miles north-west from here, will shortly be equipped with a 30-ton cyanide plant. The property has recently been taken over by a new company. John L. Whipple is president. A. E. Place, secretary-treasurer, is connected with the Zinc Chemical Co., Inc., a company now erecting a plant at Los Angeles for the manufacture of zinc oxide. The company owns six patented claims and an ample water-supply. The ore is hard and contains no slime-forming elements, such as clay, which facilitates the treatment proposed in the preliminary 30-ton plant. It is stated that about 150,000 tons of ore available for treatment has been developed. During the week ending September 23, the Prince Consolidated shipped 1330 tons of ore; the Virginia Louise, 780; the Combined Metals, 210; the Black Metals, 100; the Bristol Silver Mines, 95; and the Magnolia mine, 40; making a total of 2555 tons. The Belle Helen silver mine 50 miles east of Tonopah has been sold by its owner, T. T. Cornforth, to Los Angeles and Goldfield parties. A large cash payment was made.

NEW MEXICO

MEETING OF STATE CHAPTER OF THE AMERICAN MINING CONGRESS.

SILVER CITY.—Mining men of New Mexico met in Silver City, Monday, October 4, for the purpose of completing the organization of a State chapter of the American Mining Congress. Assistance will be rendered the meeting by Herbert Wilson Smith, Chief of the War Minerals Division of the A. M. C. of Washington, D. C., and John T. Burns, assistant secretary of the same organization.

PINOS ALTOS.—At the Silver Reef group, situated about two miles east of the Silver Cell, the 65-ft. shaft is being unwatered and deepened. The mine was worked more than 30 years ago by a Mr. Bennett and it is said that from this 65-ft. shaft 10 tons of ore were shipped that averaged $508 per ton. The vein is narrow but the ore is of high value and shows no lead or zinc.

GRANT COUNTY.—It is reported that through the efforts of C. W. Mitchell, manager for the Montclair Mining Co., owning the Cora Miller mine on the Mangas, a group of New York capitalists has become interested in the mining possibilities of Grant county. One of the

properties being examined is the Long Hope, situated in the Fleming district, less than five miles north-west of Silver City. The ore contains silver chloride and silver sulphide and is reported to assay from 25 to 100 oz. per ton.

SIERRA COUNTY.—Plans are under way for the installation of a chloride roasting and leaching-plant at the mines of the Moffitt Mines Co., on North Percha, Kingston district.

UTAH

UTAH SULPHUR CORPORATION'S LEACHING-PLANT NEARLY COMPLETED.

SALT LAKE CITY—During the week ending September 25, the Utah Ore Sampling Co. released from its Murray sampling-mill 87 cars of ore from Utah mines, 13 from Nevada, 3 from California, 3 from Montana, and 1 from Idaho. At its Tintic mill the company released 35 cars from Utah mines.

ALTA. During September shipments from the South Hecla mine totaled about 25 cars, according to George H. Watson, the manager. Development and production has been retarded in recent months by a serious shortage of labor. The Albion Consolidated drain and transportation tunnel, which is being driven to open in depth rich ore-shoots mined in the upper levels, is going ahead at the rate of 125 ft. per month.

The Columbus-Rexall property was never in better shape than at present, according to M. R. Evans, president of the company. From September 1 to 24 the company shipped 8 carloads of ore averaging more than $50 per ton. If men were available the output could be doubled. The company has laid in sufficient stores to continue operations throughout the winter. The first snow of the season fell on September 24, but weather conditions were probably such that shipments can be made for several weeks yet.

SANTAQUIN.—At the present time the Union Chief Mining Co. is prospecting a mineralized limestone that is cut by a number of ore-bearing fissures, according to the general manager, G. L. Bemis. From this development work five cars of good shipping lead-silver ore have been taken and are now awaiting transportation. On account of the large amount of road construction and work in the Tintic district, men and teams are so scare that the company is unable to secure teams for hauling ore.

EUREKA.—During the week ending September 25, the Chief Consolidated shipped 32 cars of ore; Tintic Standard, 28; Mammoth, 31; Dragon, 13; Eagle & Blue Bell, 11; Iron King, 5; Iron Blossom, 4; Grand Central, 4; Swansea, 3; Centennial-Eureka, 3; Bullion Beck, 3; Colorado, 1; Victoria, 1; Gemini, 1; Griggs-Huish, 1; Yankee, 1; a total of 143 cars. Fearing that the railroad companies are preparing to appeal from the decision of the State Public Utilities Commission prohibiting an advance in freight-rates on intra-state shipments of ore and coal, local mining men are not only preparing to oppose such an act, but are advocating a movement to secure reductions in existing rates, which they contend are crippling the mining industry. The mine owners are preparing to meet the railroads in any fight which may be brought about for the purpose of increasing freight-rates on ore. It is a question of life or death for some of the mining companies, and it does not seem reasonable to suppose that the Interstate Commerce Commission will interfere. It is claimed that the rates on ore from Utah mines are now higher than those existing outside the State, and the same may be said of the rates on coal.

Directors of the Lehi-Tintic property have decided to sink a shaft, according to Charles Zabriskie, president of the company. Orders have been placed for the necessary hoisting and other equipment. The shaft will be sunk from the lower level to a depth of 500 ft. No deep work has been done; the prospecting consists of adits.

Work has been resumed at the property of the Scran-

HOSTOTIPAQUILLO DISTRICT

ton Mining Co. after a shut-down of more than a month. When the increased freight-rates went into effect an August 26, shipments were suspended. The ore is a zinc-lead product and is being shipped now to Colorado, the burden of the increased freight-rate being borne by the purchasers. For some time past this property has been worked by James Wade and associates of Salt Lake City, who, in turn, have sub-let parts of the mine to other lessees. About two carloads per week are now being shipped from the property.

BEAVER COUNTY.—M. P. Morrissey, president of the Utah Sulphur Corporation, says that the company's new leaching-plant, which will have a capacity of 250 tons per day, will be completed and put in commission by November 1. In order that the work might be rushed on this plant, the company stopped taking orders about midsummer, operating the retorts and sub-limer only to such an extent as would care for orders already on the books. With the leaching-plant in commission, the company expects its output of sulphur to be not less than 350 tons per day. Mr. Morrissey states that the leaching-plant

will enable the company to produce sulphur at a smaller cost than the present methods. The sub-limer is used for making 'flowers of sulphur'. While in Chicago recently Mr. Morrissey made arrangements for entering an entirely new line, that of making a fertilizer by combining sulphur and phosphate rock. The Utah Sulphur Corporation will erect a plant in Chicago with a capacity of 150 tons of fertilizer per day, and it is believed that it will be in operation by midwinter.

Park City.—At the Keystone property, two levels are being extended and three raises are being made. In the face of the K-K-3 level, exceptionally good ore is being mined; assays showing from 35 to 40% lead and about 15 oz. silver. At the present time the property is shipping only the ore taken out in development. Forty men are now employed, and ample stores are being put in to permit work throughout the winter. The company has secured the old Kearns-Keith mill, which is being put into shape for handling the low-grade ore.

At the Ontario Silver Mining Co.'s property, which is under the same management as the Keystone, it is stated that some of the richest silver ore ever discovered has been found on the 2000-ft. level, the deepest in the mine. A break in the machinery prevented the handling of water that came in at about the time the ore was found and the company immediately ordered a new pump, which has arrived at the property and is now being installed.

A rich showing has been developed north-east of the O'Brien stope in the Silver King Coalition mine, according to the manager, M. J. Dailey. The strike is on the 1100-ft. level and is important because it was discovered in virgin territory. The strike made some weeks ago between the 1200 and 1250-ft. levels continues to show improvement. These two developments are the most important made in the Coalition property in recent years.

BRITISH COLUMBIA

A POSSIBILITY THAT GOVERNMENT FUEL-CONTROL WILL BE RESTORED.

Trail.—The ore receipts at the smelter for the week ended September 21 amounted to 8810 tons, the Consolidated M. & S. Co. mines contributing 7846 tons toward the total. The other shippers were: Bluebell, Riondel, 175 tons; Josie, Rossland, 223; Mandy, Le Pas, 65; Monarch, Field, 45; North Star, Kimberley, 224; Ruth, Cedar Creek, 108; Silver Bear, Zpicky, 28; Skyline, Cedar Creek, 37; Velvet, Rossland, 31; and Texas Yankee Girl, Ymir, 29.

Rube and Carl Laib, owners of the Spokane group in the Bayonne district near Nelson, are seeking government aid in the construction of a 150-mile pack-trail down Canyon creek to Kootenay lake. Rube Laib states that such a trail would provide means for shipping ore from the mines economically and would put the properties on a working basis. Ore from the Spokane property to Trail has been carried up a steep pass to the headwaters of Sheep creek and out by way of Salmo. The cost of transportation from the mine to Salmo has been $45 per ton.

Edgewood, Arrow Lakes.—Considerable activity is reported in the Lightning Peak district, and undoubtedly this district would attract a good deal more attention but for the bad state of transportation. E. H. McDonald has been examining a number of properties recently in the interest of Billings, Montana, people. A one-foot vein, said to carry gold and silver in paying quantities, has been cut by the main tunnel on the Rampallo group at a distance of 40 ft. from the portal. The tunnel is being driven to cut a body of ore which down to a depth of 20 ft. gave average returns of $10 in gold and 250 oz. of silver per ton. The tunnel should cut this orebody at a depth of 150 ft. after it has been driven for another 260 ft. Rendels & Co. is sacking high-grade at its Waterloo claim, and expects to have 800 sacks filled for transportation over the winter snow. W. J. Banting has struck a foot stringer of solid galena in a six-foot vein of milling-ore at the Killarney group.

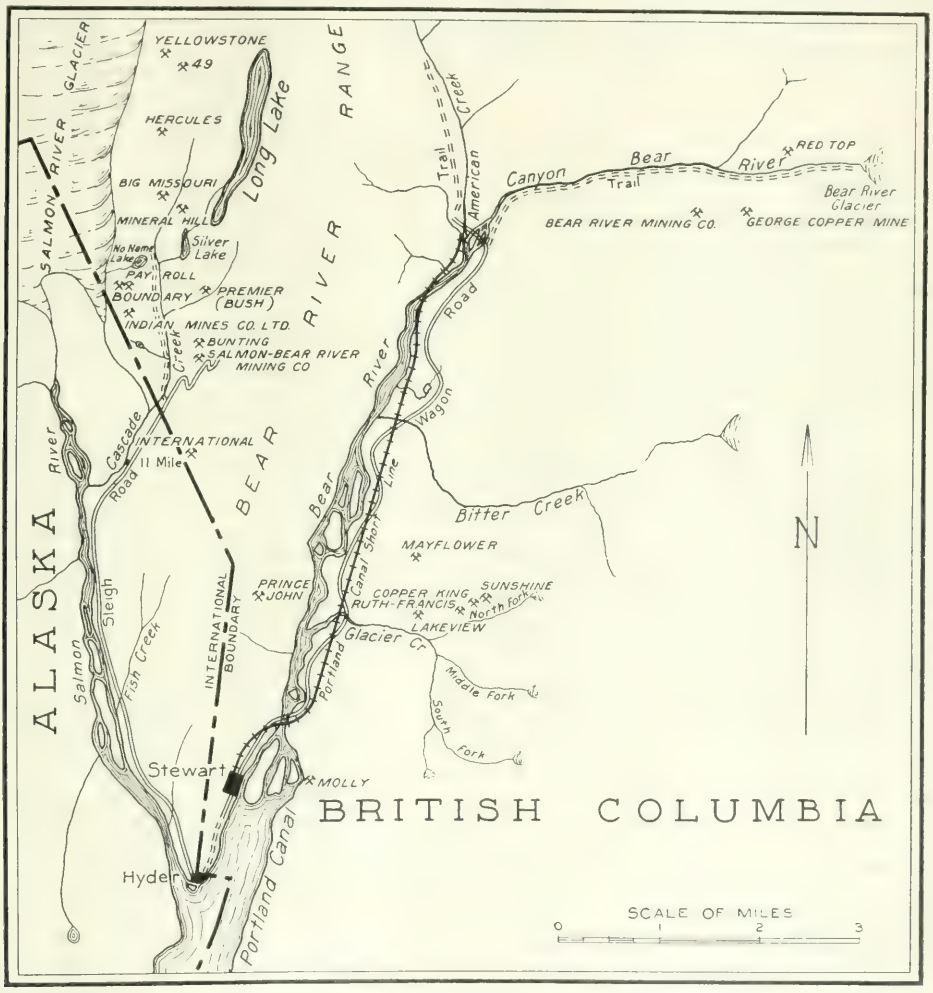
Vancouver.—The Geological Survey men are returning from their summer's field work. R. W. Brock, of the University of British Columbia, reports promising indications of silver-lead ores and some copper ores in the inner flank of the Coast range, west of Burns lake. He describes the country as exceedingly rugged and states that little prospecting has been done. Victor Dolmage, who has been on the west coast of Vancouver island during the summer, reports the occurrence of mercury ores at Sechart, Barclay sound, but doubts whether either grade or quantity is commercial. He reports important deposits of copper ores and magnetites at Nootka sound, where considerable work is being done on them. Officials of the Granby Consolidated M. S. & P. Co. state that by sending the company's blister-copper through the Panama Canal, instead of by rail, not only is the cost reduced by nearly half, but the time of transportation from Anyox to Long Island, New York, will be reduced from 60 days to 45 days.

Nelson.—A galena property has been located at Nakusp on the Arrow lakes. The claim is known as the Lucky Rose and is especially interesting for the reason that this section has not hitherto been considered as possessing mineral possibilities. Already a lode has been uncovered for 300 ft. and assays of 49 oz. silver and $1.80 in gold are reported.

Kaslo.—John Keen, speaker for the Provincial legislature, has just returned from a trip through the Lardeau district. He visited the Lardo, Trout Lake, Ferguson, and other points. Mining, he says, is rather quiet. The Triune, True Fissure, and other claims look well, while the lessees on the Silver Cup and Nettie L. have made good progress and have ore ready to ship. The Gold Cure is promising. He said that the labor situation was showing marked improvement, men were going back to the camps seeking employment and the indications are that in a short time the trouble which has been experienced during the past few months will be settled.

Greenwood.—The Lightning Peak mining section is

being opened by the construction of a trail, under the terms of the Mineral Survey and Development Act. The Provincial government has been busy on this for a large part of the past season, and the work now is reported to be practically completed. Lightning Peak has an elevation of about 7500 ft. In that locality are situated



a number of mining properties, among which is the Waterloo, that give promise of developing into important mines. On the completion of the trail it will be possible to make the trip with pack-horses from Greenwood to the peak in four days.

VICTORIA.—A small force of men has been employed since last March on the Gabbro Copper Mines, Ltd., situated at Jordon River, Vancouver island. Several large open-cuts have been made to ascertain the grade and size of the orebodies. Some good ore has been taken from a tunnel driven on Sinn Fein creek, but the most promising showings were found on the Sunlock Cave Zone where it crosses the Jordon river into the Gabbro group. The open-cuts referred to have established a width of 5 to 25 ft. of mineralized material having a length of between 300 and 400 ft. There is a considerable body averaging 3% copper or better, which is the best surface showing yet found in the Jordon River section. The orebodies on the Gabbro group are in basalts of Eocene age, which have been intruded by a stock of gabbro. There has been much shearing of the basalts, due probably in part to the shrinkage of the gabbro mass when cooling, and also to regional stresses. There has also been some shearing and ore deposition in the gabbro. Continuity of the ore at depth in these shear-zones is shown by the tunnels on the adjoining Sunlock property, which indicate a vertical depth of over 500 ft. The Sunlock is one of the very few mines in this Province that has had no serious set-back since the beginning of mining operations on it in 1917.

It appears from Ottawa dispatches that there is a probality that the fuel-control system in force during the War will be re-introduced shortly. Under this system each Province had its own commission, whose duty it was to see that there was a fair distribution of the available supply of coal. The Railway Board, under whose jurisdiction the fuel control is placed, has not definitely decided to restore the regulation as yet, but promises that definite announcement will be made in a few days. Whether this proposal will affect British Columbia is a question.

ONTARIO

OIL-FLOTATION OF TAILING IN COBALT LAKE IS A SUCCESS.

PORCUPINE.—While hitherto most of the development on the Hollinger Consolidated has been done above the 425-ft. level, preparations are now being made for opening up the lower levels on an extensive scale. A winze was sunk to a depth of 1250 ft. some years ago to prove the downward continuation of the ore, and this having been done work was stopped. The lower workings are now being dewatered and a raise will be made from the 1250-ft. level to the central shaft. The company has declared another one per cent dividend, being the third consecutive four-weekly payment. The Dome Mines is treating about 1000 tons of ore per day, working under the disadvantage of a shortage of labor. The ore taken from the stopes is considerably richer than was estimated. It is stated that large quantities, the gold content of which was placed at about $4 per ton, are actually yielding upward of $6. The Vipond-North Thompson is being re-opened, operations being in charge of W. S. Gowans, formerly of the Dome Mines staff. J. B. McArthur, a prominent British mining engineer, and Major J. McIntosh Bell are acting in an advisory capacity.

KIRKLAND LAKE.—Conrad E. Weltlaufer, president of the Orr Gold Mines, has issued a statement to the shareholders announcing that funds have been procured and the debt of the company paid. J. C. Houston has been engaged as engineer. A vei supposed to be No. 1 vein of the Lake Shore, has been cut and is found to be 5 ft. wide and well mineralized. Reference is made to the proposed consolidation of the Orr with "two operating companies" which will come up for consideration at the annual meeting on September 30.

SKEAD TOWNSHIP.—There is considerable activity in this district and many new properties are being developed. At the Fidelity, an 8-ft. vein showing free gold was uncovered in stripping a schisted porphyry dike. The shaft on the originally discovered vein is being sunk to the 100-ft. level. The Crawford-Skead is putting down a shaft by hand-steel on a vein carrying gold over a width of 8 ft. Several other veins have been found by stripping and trenching. The Skead Gold Mining Co. has a group of claims on the east shore of St. Anthony lake, which it is preparing to develop having constructed four miles of road to provide transportation. On the Meany claims in north-east Skead, where an important find was made this summer, camps are being erected. The Manley claims, which attracted attention to this field a year ago on account of a spectacular discovery, are again being worked by Walter Manley and associates.

COBALT.—The mines in the Cobalt district are operating with a shortage of about 10% of the labor required. Great difficulty is being experienced in procuring shovelers, and skilled men are being employed on this work. The cost of producing silver is likely to increase during the closing quarter of the year owing to the shortage of labor as well as to an increase in freight-rates. Dispatches which carry the information that the price of cotton, leather, and machinery has commenced to decrease convey the hope that these favorable factors may offset the adverse influences.

On October 30 the Coniagas Mines will finish a favorable fiscal year. An average of 500 tons of ore is being treated daily, 100 tons of which is treated by cyanidation in the Buffalo mill of the Mining corporation. The mill heading averages from 8 to 10 oz. per ton, as compared with 13.07 oz. during the preceding year. Arrangements are being made to increase the amount treated to 600 tons daily, and it is believed that output can be well maintained during the coming year.

Net earnings at the McKinley-Darragh are slightly under dividend requirements at the rate of 3% quarterly. The company has a surplus of about $365,000 and it is understood the deficit in net earnings below dividend requirements of $67,000 every three months may be drawn from the surplus, and the current rate of disbursement maintained for a considerable period. At a depth of 350 ft. on the Keeley Silver Mines, in South Lorrain, vein No. 9 has been cut, and shows a width of 14 in. containing from 200 to 400 oz. silver per ton. The cross-cut is being driven toward the Beaver Lake vein, which is believed to lie 35 ft. farther north. The 20-stamp mill is expected to be ready for operation by the end of November. Twelve sacks of ore containing 2000 oz. of silver per ton has been cobbed from the dumps on the Silver Bullion property at Leroy Lake in the Gowganda district. The installation of a small mining plant has been completed and tenders are being called for several hundred feet of underground work.

The La Rose is working its different properties steadily. On the University the ore-shoot has been followed up for 175 ft. and the drift is still in ore. It is for the most part good milling-ore with patches of high-grade. The Princess property is the most important producer. Considerable ore is being taken out along the McKinley-Darragh boundary. The original La Rose claim continues to yield good milling-ore. A meeting of the shareholders of the Temiskaming has been called for October 7 to consider the proposal to purchase a half interest in the Blue Diamond Coal Mines and the Canadian Coalfields, Ltd., in Alberta, lately secured by the McIntyre of Porcupine.

ELK LAKE.—The Reeves-Dobie has gone into the hands of a receiver and 213 bags of concentrate in transit have been seized to satisfy a judgment against the company for wages. Silver has been found on the Regent property recently opened in James township.

CALIFORNIA

Amador County.—At the old Eureka mine (Hetty Green's old property) development work under way on the 3500-ft. level has uncovered rock of better character than any found thus far on other levels since the re-opening of the property. An ore strike of great importance to the Plymouth Consolidated Mining Co. has been made. A 12-ft. vein of rock assaying from $10 to $15 per ton has been struck on the 2050-ft. level, and development work so far done on it indicates its likelihood to yield well for some time to come. The find is particularly encouraging at this time, when the mine's ore-reserves have become limited.

Calaveras County.—Ray Lantson and A. S. Kingsberry, employees of the California Mining Co., lost their lives in a mine fire. The fire broke out in the main shaft September 30 and destroyed the surface equipment. Lantson volunteered to go into the mine by another shaft and turn on the pumps. He did not return and A. L. Riggs and Kingsberry went below to rescue him. Kingsberry was also overcome but Riggs escaped. It is reported that the men wore army masks which are not adapted for use against mine-fire gases. The rescue trucks arrived too late.

Placer County.—For the third time in her history, Iowa Hill, one of the old hydraulic mining camps of Superior, California, has been swept by a disastrous fire, the loss being estimated at between $35,000 and $40,000. Twenty-six buildings were destroyed, including the school-house, a hotel, and the Methodist Church. Not more than seven houses escaped the flames.

Shasta County.—The Arps Mining Co., which has operated the Arps group of copper mines near Copper City for four or five years, has deeded the mines back to the original owners, R. M. Seltzer, Anton Jaegel, William Arps, and Mrs. Mary Ruoff.——The Mountain Copper Co.'s new roller crushing-plant near the Hornet mine above Keswick will be ready to begin crushing about October 15. This plant is designed for the fine crushing of pyrite from the Hornet mine and will have a capacity of 600 tons per day. Unfortunately the copper situation is still unfavorable and the Mountain Copper Co.'s Iron Mountain copper mine, near the Hornet, remains closed.

IDAHO

Coeur d'Alene—The Federal Mining & Smelting Co., owning several claims in the Coeur d'Alene, has let a contract for sinking an additional 200 ft. on the Morning mine, giving it a depth of 1400 ft. below the main working tunnel. With the completion of the contract a cross-cut will be run to the main vein and the body of ore which has been opened on the 1200-ft. level will be developed on the 1400-ft. level. The lower levels of the Morning mine are showing the best ore found in the property for some time. Development of the Idaho Northern property, five miles east of Murray, is to be resumed after many months of idleness, and a compressor has been delivered to the property for the purpose of running a 1600-ft. cross-cut adit which will open the ore at a depth of 1300 to 1400 ft. An adit already has been run in the property for a distance of 370 ft. and work has been completed which opens two large veins at a depth of 300 or 400 ft. One of the veins carries lead, silver, gold, and copper to a value of $50 per ton. Buildings have been started on the property for men and equipment.

MONTANA

Butte.—The situation in the Butte camp continues unusually quiet, but the increase in the average of working shifts from 33% to 45% of normal within the last month would indicate a slight improvement. All officials are confident that demand for copper will increase after the fall elections are out of the way. At the Davis-Daly an excellent 25-ft. orebody continues to hold up on the 2700-ft. level. This is the same body which with a 14-ft. showing was drifted on for several months. The ore is all first class 5% or better and the vein is the third distinct orebody encountered on the 2700-ft. level. At the Hibernia of the Davis-Daly cross-cutting is in progress on the 600-ft. level following completion of a station at this level. At the Boston-Montana mine work will be started soon on erection of a flotation plant. Drifting is in progress on several veins on the 300-ft. level. Shipments from the Emma mine of the Butte Copper & Zinc Co. for August amounted to 8000 tons of manganese ore and 4000 tons of zinc ore, with the manganese running 37½% and the latter averaging 15% zinc, 6 oz. silver, and 5% lead, according to the 'Boston News Bureau'. Of the manganese tonnage, two-thirds is being shipped to the ferro-manganese plant of the Anaconda Copper Mining Co. at Great Falls, which is operating the Emma under a long-term lease on a 50-50 profit-sharing basis. The balance of the manganese is being shipped to the Carnegie steel plants in the Pittsburgh district.

Great Falls.—Petition of State Attorney General S. C. Ford for an injunction restraining the Cascade Silver Mines & Mills Co. from dumping the tailing from its Neihart mill into Belt creek, in Cascade county, failed in the Great Falls district court. In an order issued today by Judge H. H. Ewing the injunction was denied. The company was awarded costs in connection with the suit and the attorney general's action dismissed.

NEVADA

Virginia City.—The Gold Hill mine operators have issued a statement to the effect that they do not consider the Gold Hill Miners' Union responsible, and decline to recognize it or consider its demands. The operators claim the union is composed of only twenty men and that the notices branding the camp and operators as unfair were posted by authority of ten men. The operators further assert the United Comstock Co. alone employs 160 men normally, and has 70 men at work at present. It is also charged that about twenty men called the authorized strike and violated an agreement providing for a notice of thirty days before a strike or lockout would be effective.

The Gold Hill Miners' Union has posted notices at Gold Hill and Virginia City warning all union men to remain away from Gold Hill. The camp is branded as unfair, as are all men and contractors working on the Gold Hill properties, excepting the Comstock Home mine. This action follows the refusal of the Gold Hill companies to grant $6 per day to miners. The old scale is $5. It is reported that operators have practically decided to close their properties until next spring.

MEXICO

Sonora.—The Soyopa Silver Mining Co., a newly organized corporation of Nogales, Sonora, has purchased the famous old Hidalgo mine from R. G. Platt. Several thousand tons of high-grade milling-ore are blocked out already, and further active development will be undertaken at once. The Soyopa is an ancient high-grade silver district.

Active mining operations on the Catalina property, near Cananea, will be undertaken as soon as the new power-plant is completed. A new turbine and boilers are being installed. The shaft is being sunk an additional 1200 ft. A large part of the American employees of the Democrata mine, which recently closed down, are now with the Catalina.

Lack of a stable government in Mexico has had a disastrous effect on many mining companies operating in the more remote districts. The experience of the Batopilas Mining Co. is typical. In a circular to the stockholders the president says:

"In September 1913 our general manager and other American employees were called out of Mexico by the U. S. Department of State through the U. S. Consul at Chihuahua. In August 1914 an edict was issued from the office of the Governor of the State of Chihuahua to the effect that all mines not fully operated by their owners on September 1 would be declared open for denouncement. The general manager with several American employees returned to Batopilas and under great difficulties carried on some work until they were again notified by the Department of State to leave for the United States, having been in Batopilas about one year. During the absence of the American employees it was found necessary to allow the Mexican miners to work the mines on shares as the people were starving and threatened to enter and work the mines. These operations were supervised by our Mexican employees who, as best they might, safeguarded the company's interest. During the years 1916, 1917, 1918, and part of 1919 the company's one-third share of the product barely sufficed to cover the expense of supervision and guarding the properties of the company. In April 1919 the company commenced to take advantage of the increase in value of silver and shipped the silver bullion obtained from its one-third of the shareworkers' product to the United States and introduced Mexican gold to pay its employees. In December 1919 the general manager, John R. Harbottle, returned alone to Batopilas and has renewed and renovated the cyanide plant and has shipped out monthly small amounts of silver, the result of working up the low-grade ores and concentrates that had accumulated, as well as the company's one-third of the ores received from the shareworkers. . . . The attitude of the Carranza government was inimical to the development of foreign-owned properties. In the face of absolute lack of protection for our employees and properties, the taxes on our mining properties and the taxes on silver produced were enormously increased. This course was directly opposite to that of the former Mexican government which had encouraged the acquisition of large holdings of mining properties by a reduction in taxes on large areas. As a result of the various Carranza edicts, which are always accompanied by threats of forfeiture, the company has been compelled to relinquish some of its holdings that had been acquired under its contract, with the Mexican government, which specified that 100 mining claims (of about 2½ acres each) should be taken up each year. As the mining taxes were increased from three pesos per year on each claim to 18 pesos it became necessary to give up the unproductive claims, reserving only those properties that have produced silver in the past or that gave indications of being of value, including most of the original mines held, prior to the contract mentioned. Mining taxes and taxes on water power have been paid to date. Aside from the bond interest past due, the company has funds to more than cover all current liabilities."

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

D. M. Riordan is in New York.

W. J. Loring is at Lovelock, Nevada.

Charles Butters has gone to New York.

J. Power Hutchins is residing at Madrid, Spain.

W. W. Mein has returned to New York from California.

Eugene Dawson is on his way from New York to Iquito, in Peru.

A. W. Newberry has removed his office to 2 Rector street, New York.

John A. Rice has returned to San Francisco from Chihuahua, Mexico.

J. B. Stoddard, of the Stoddard Oil Co., New York, is at the Palace.

C. T. Hutchinson, business manager of the 'M. & S. P.' is in New York.

Francis M. Hartman, of Tucson, Arizona, is at the St. Francis hotel.

E. T. Keller, of Winnemucca, Nevada, was in San Francisco this week.

C. W. Purington has been examining coalfields on the island of Saghalin.

Olof Wenstrom has moved his offices from Boston to 60 Broadway, New York.

F. R. Weeks has returned to New York from the Salmon River district, in Idaho.

Charles Janin has returned from the Malay States and is now on his ranch near Santa Barbara.

Charles Smith, president of the Arizona Commercial Mining Co., visited the Globe district last week.

R. H. Page, general manager for the Truscon Steel Co., is here on his way from New York to the Orient.

J. Parke Channing is at Miami. He will attend the meeting of Engineering Council at Chicago on October 21.

Alfred H. Brooks, on his return from the North, stopped at Ketchikan to examine the copper deposits of that district.

John Kiddie, superintendent, and **J. G. Cooper,** auditor for the Arizona Copper Co., have been spending a few days at Tyrone, New Mexico.

H. Y. Eagle, mining engineer connected with the New York office of the Union Minière du Haut Katanga, has been visiting mining and metallurgical plants in Utah.

Ira B. Joralemon has been elected commander of the American Legion post at Bisbee; he is assistant general manager for the Calumet & Arizona Mining Co., at Bisbee.

Homer Guck, who was correspondent for the 'M. & S. P.' at Houghton, Michigan, for many years, is now associated with the Detroit Life Insurance Co. as assistant to the president.

R. E. Tremoureux, formerly manager of the Champion mines at Nevada City, has opened offices in the Hobart building, San Francisco, where he will specialize in machinery and supplies for mines.

Henry N. Thomson, at one time head chemist for the Anaconda company and later superintendent of the International smelter, at Tooele, Utah, has been appointed to the chair of metallurgy in the University of British Columbia, Vancouver.

W. H. Webster, assistant general manager of the Copper Queen branch of the Phelps Dodge Corporation, and **H. Kenyon Burch,** consulting construction engineer for the Phelps Dodge Corporation, have been visiting various mining districts in New Mexico.

METAL PRICES

San Francisco, October 5

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9 50
Copper, electrolytic, cents per pound	18 75
Lead, pig, cents per pound	8 00—9 00
Platinum, pure, per ounce	$115
Platinum, 10% iridium, per ounce	$155
Quicksilver, per flask of 75 lb	$75
Spelter, cents per pound	9 50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

October 4.—Copper is inactive but easy. Lead is dull and weak. Zinc is quiet and lower.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Sept. 28	93.00	59.37	Aug. 23	99.12	61.60
" 29	92.25	59.12	" 30	96.61	60.70
" 30	92.00	59.37	Sept. 6	93.27	58.90
Oct. 1	91.50	59.00	" 13	93.96	59.15
" 2	91.00	58.75	" 20	94.31	60.08
" 3 Sunday			" 27	93.52	59.66
" 4	90.12	58.25	Oct. 4	91.65	58.98

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	93.66
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Sept. 28	18.50	Aug. 23	19.00
" 29	18.50	" 30	19.00
" 30	18.50	Sept. 6	19.00
Oct. 1	18.75	" 13	18.75
" 2	18.50	" 20	18.75
" 3 Sunday		" 27	18.70
" 4	18.50	Oct. 4	18.50

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.35	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	18.75
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Sept. 28	7.75	Aug. 23	9.19
" 29	7.50	" 30	8.85
" 30	7.50	Sept. 6	8.55
Oct. 1	7.50	" 13	8.29
" 2	7.50	" 20	8.06
" 3 Sunday		" 27	7.85
" 4	7.50	Oct. 4	7.54

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	8.03	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	8.58	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	8.08
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.99	5.04	8.55	Nov.	8.05	6.58	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.50	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	....
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Sept. 28	7.70	Aug. 23	8.42
" 29	7.65	" 30	8.45
" 30	7.65	Sept. 6	8.29
Oct. 1	7.65	" 13	7.78
" 2	7.65	" 20	7.83
" 3 Sunday		" 27	7.73
" 4	7.65	Oct. 4	7.66

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.78	7.57	7.84
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date			
Sept. 7	75.00	Sept. 21	75.00
" 14	75.00	" 28	75.00
		Oct. 5	75.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	75.00
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

FEDERAL TAXATION

William B. Colver, of the Federal Trade Commission, speaking before the National Association of Cotton Manufacturers, described the procedure of the Federal Trade Commission and urged modification of the anti-trust laws that he believed would bear less harshly on business and yet more fully serve the public interest than do the present laws. Taking up the question of taxation he continued: "We must soon decide upon a taxation policy which will distribute the burden equitably and bear with the least possible weight upon the processes of industry and commerce and so bear, as lightly as such a gigantic load can be made to bear, upon the ultimate consumer, which is every single one of us. Unwise taxation must inevitably act as a brake upon business which will reduce production and hinder distribution. The excess-profits tax and to a degree the higher schedules of the income-tax are striking examples. It is quite easy and extremely popular to say 'tax the rich'. But what we are actually doing now is to tax the capital of the rich out of productive enterprises and into non-productive. As the law now stands, a man with a $20,000 income can invest in state or municipal bonds, non-taxable at 4½% and with practically no risk, while to net the same rate of income any investment in industry or trade must yield him 5 1/3%, to say nothing of the element of risk. The man with a $50,000 income must receive 6½% from his productive investment in order to be able to pay his tax and yet net the 4½% that the non-taxable offers him. The $100,000 income must earn 10¾%, and the $500,000 income must earn 15% in order to net the sure 4½% that the non-taxable state and municipal bonds pay. Thus we see an outpouring of all sorts of state, county, and municipal bonds and an orgy of public expenditures for 'public improvements' which, however desirable, are not productive enterprises. We see hundreds of millions of dollars taxed out of business and into tax-free bonds. The end of that road is business disaster.

"The present Congress made a total appropriation of $5,686,005,706 for the fiscal year 1920. This sum will be added to through deficiency appropriations. The money to meet these appropriations must be raised by taxation. If the taxes continue to [illegible] at present unanimous effort at production, upon every investment of capital in productive enterprise and upon every productive effort or human being, it will act as a drag upon and an impediment to production. To the extent that production is slowed up or diminished, supply will tend to decrease in proportion to demand and in proportion to the public need. As supply tends to fail to meet demand prices tend to go upward. So that a tax upon productive effort and productive property, and upon [illegible] as many [illegible] latest into higher prices which means in more and cost of living.

"Believing, as I do, that the high cost of living rests directly on taxation, and believing that taxation cannot be materially reduced, it seems to me that some method of taxation must be sought which will stimulate production rather than impede it, so that as supply tends to catch up with demand prices will tend to fall. Therefore I would attack the high cost of living by applying taxation to idleness, to non-production, and to speculation."

MONEY AND EXCHANGE

Foreign quotations on October 5 are as follows:

Sterling, dollars	Cable	3.49⅝
	Demand	3.50⅜
Francs, cents	Cable	6.76
	Demand	6.77
Lire, cents	Demand	4.13
Marks, cents		1.69

Eastern Metal Market

New York, September 29.

Depression in most of the markets is pronounced and prices are lower. Low exchange values are a factor as well as imported metals.

Demand for copper is lighter than in many weeks and there is some weakness in values.

The tin market is exceedingly quiet with prices on the decline.

In lead there have been further price reductions with imported metal the large factor.

Buying of zinc is erratic and light and imports are an influence. Prices are lower.

There is no change in antimony.

IRON AND STEEL

The reductions in automobile and other prices in the past week have caused further shrinkage in iron and steel buying, and in a number of directions the market has shown weakness, says 'The Iron Age'. Accompanying the cut made by the Ford Motor Co. is a determined effort to force down the price of automobile steel. The Detroit company is expected shortly to buy steel on a large scale for 1921 and already some makers of automobile parts have been urged to make a downward revision of existing contracts. At the same time, the periods within which the mills can make deliveries on new orders have been shortened in a number of cases, pointing to a more rapid adjustment between supply and demand than seemed likely two months ago.

Among steel products, billets, plates, and sheets have furnished the chief tests on prices in the past week and all have yielded. The general tendency of pig-iron prices is decidedly toward lower levels.

COPPER

The unexpected has thus far developed in this market. The buying movement which was predicted and to which all signs pointed a few weeks ago has not developed and seems farther away than ever. Both inquiry and demand have fallen away and the apathy of buyers is hard to explain. There is perplexity among some leading representatives of the trade. While pessimism does not rule, the present situation is eminently unsatisfactory and the immediate future is hard to prophesy. There is almost no business. What there is is being satisfied by small producers and dealers at around 18.50c., New York, for both electrolytic and Lake copper. We quote the market at this level. Prices of most leading producers are nominal at 18.75c., New York, for October, with 19c. asked for forward positions, but they are booking but little for any positions. Low exchange-rates and disturbed political conditions abroad are unfavorable to export business, which is not as good as it was. Arrivals of copper from abroad are also a factor. They have totaled 6860 tons thus far this month. Importations of scrap copper of good quality from war material are also a factor in diminishing the demand for domestic virgin-metal.

The British copper market reached the highest level in four months on September 15 when it was £100 per ton, or about 17.50c. per pound. It has softened since, until yesterday it was £95 5s. per ton.

TIN

This market is extremely dull. Dealers are going slowly in their purchases and consumers are not active. There are no features. Sales of small lots under the hammer on the New York Metal Exchange continue, those for the week amounting to about 125 tons at prices ranging from 43.25 to 44.50c., depending on the position. On the 20th there was a sale of 25 tons under the rule at 44.50c. and on the 21st another sale of 25 tons of July-August shipment at 44.37½c. The London market yesterday was lower than a week ago with spot standard quoted at £270 15s. per ton, future standard at £276 15s., and spot Straits at £273 15s., the week's decline being from £1 to £2. Arrivals thus far this month have been 3910 tons with 4385 tons reported afloat.

LEAD

Imported metal continues the dominant factor. Prices have again declined. The principal event of this nature was the reduction late last Thursday of ½c. per pound in the quotations of the American Smelting & Refining Co. to 7.75c., St. Louis, or 8c., New York. This represents a readjustment to the level of the outside market. Arrivals from abroad continue with the feature consisting in lead from Germany, the first in many years. German lead for October shipment has been offered at 7.50c., New York, duty paid. Spot foreign lead is available at 7.75c., New York, which is quoted by the New York market. Domestic lead is quoted at 7.75c., St. Louis. There is much interest by buyers in either foreign or domestic metal, the buying apparently consisting of hand-to-mouth orders. Consumers are evidently not buying for stocks. It is estimated that close to 20,000 tons has been contracted for importation.

ZINC

Prime Western sold to England and re-shipped to this country is the principal influence in the Eastern market. It is available and sold at around 7.70c., seaboard, which establishes the New York market. Domestic prime Western is quoted at around 7.70c., St. Louis, for early delivery and there have been a few sales at 7.70 to 7.80c. Demand in general is light from any quarter. Consumers are buying only for immediate needs and producers are selling only what they have to. For forward positions they are not quoting if possible, nor are they forcing the nearby market.

ANTIMONY

The market is quiet and unchanged with wholesale lots for early delivery quoted at 7.12½c., New York, duty paid.

ALUMINUM

Quotations are unchanged, that of the leading producers being 34.90c. f.o.b. producer's plant for virgin metal, with the same grade from foreign sources available at 31 to 32c. per pound, New York.

ORES

Tungsten: Business has been quiet. There have been offerings without finding buyers. Spot Chinese ore is offered at $4.75 per unit in regular concentrate and for higher-grade ore $5 per unit is the asking price. The British price is 26s. per unit with ferro-tungsten quoted at 3s. 3d. per pound of contained tungsten. American ferro-tungsten is quoted at 80c. to $1.05 per pound of contained tungsten.

Molybdenum: The market is still quiet and devoid of feature. Quotations are nominal at 65 to 75c. per pound of MoS_2 in regular concentrate.

Manganese: The market is very quiet with no interest shown by consumers, who seem well stocked. Sellers ask 60 to 65c. per unit, but buyers are willing to pay no more than 55c.

Manganese-Iron Alloys: The markets for both ferro-manganese and spiegeleisen are extremely quiet. No sales of the former are reported nor any demand. Quotations are unchanged for both British and domestic alloy on a basis of $170, seaboard. Some re-sale British alloy has been offered at $160, seaboard, but not sold so far as known. Except for the sale of 100 tons of spiegeleisen for Canada, demand is very light. Quotations are unchanged at $82.50, furnace, for the higher grade and $80 for the lower.

T. A. RICKARD, ... Editor

IT is a pleasure to publish the article on the United Verde smelter by Mr. Lewis A. Parsons. This article represents a standard of technical writing that is rarely attained by the members of the engineering profession. Another pleasing feature is the mental hospitality of the management of the United Verde Copper Company, without whose courtesy and friendly co-operation the preparation of an article so rich in detail would have been impossible.

ON page 564 we publish a statement issued by Mr. Louis T. McFadden on the subject of the Bill presented by him before Congress for the purpose of levying an excise of $10 per ounce on all gold used for manufacturing. It is surprising that the chairman of the Committee on Banking and Currency of the House of Representatives should have made such a blunder as to say that "since July 24, 1919, the British Empire has been paying an exchange premium as high as 50% to the gold producers of South Africa". Any banker in touch with foreign exchange could have told him that the premium on gold in London was the direct result of the removal of the embargo placed by the British government during the War on dealings in gold, that is, as soon as the war-time restrictions were removed the artificial value of sterling exchange dropped to its real level as measured in gold. That the gold producers of South Africa benefited from the premium was a minor consequence of the re-establishment of a free market for gold in London. Mr. McFadden has given currency to a misunderstanding that he ought to have been the first to correct.

STATISTICS of immigration are peculiarly interesting at this time, for they bear upon our economics all the way from the domestic kitchen to the largest industrial establishment. We have been cheered recently with statements from Federal officials that the tide of migration had turned strongly and that thousands were arriving daily at Ellis island, New York. Now come the figures of immigration for the first fiscal year ended on June 30. These show that 430,001 came to this country during the twelve months, while 288,315 emigrated, so that the net gain was only 141,686. Most of the newcomers hail from Mexico and Canada; the European influx was 246,295, and the efflux 256,433, so that we lost 10,000 to the trans-Atlantic countries. The total of 430,000 immigrants last year was only one-third that of 1914; moreover, of those who departed 80% were males, while of those who arrived 43% were females. Latterly there has been an improvement; during April, May, and June the male element increased 61% among the arrivals and decreased to 77% among the departures. It is estimated that an immigration of a million persons will be recorded in the current year, but we are sceptical as to that. Another important fact is that the supply of unskilled labor is being drained by emigration. During the year 183,280 laborers left our shores while only 81,734 came hither. Arrivals of skilled laborers and professional men increased in the ratio of three to one, but the supply of common labor, which is the foundation of industrial activity, decreased considerably. A shortage of at least three millions of ordinary workers was caused by the check to immigration during the War, and the exodus to Europe from this class of labor accentuated the loss. A new set of conditions has been established by the War and we shall feel their effects for many years, if not permanently.

MR. HOOVER's participation in the Presidential campaign, as a supporter of the Republican candidate, is in accord with his acceptance of Senator Harding's nomination. It has been rumored that Mr. Hoover will be in the next President's cabinet, for we assume that the Senator, not the Governor, from Ohio will be elected. Indeed, one of the arguments used by Mr. Harding's supporters is the expectation that he will select a strong Cabinet. Mr. Hoover has been mentioned as Secretary of the Treasury, with the idea that he will organize a budget system; likewise he has been slated for the Secretaryship of the Interior, for which he is qualified by his experience as an engineer. This would anticipate the bill before Congress whereby the Secretary of the Interior is to be an engineer and is to have in his department—to be changed to that of Public Works—all the engineering branches of the Federal administration. Mr. Hoover's services are valuable to the nation in whatever capacity he exercises them, but we doubt whether they can be exercised successfully under the conditions that will exist at Washington if and when Mr. Harding becomes President. He could, and would, work loyally with Mr. Harding, of course, but could or would he work harmoniously with the cabal by whom Mr. Harding will have been hoisted into office? Mr. Hoover is young; he will find other opportunities of devoting himself to public service; we hope that he will not jeopardize his remark-

able usefulness in this day and generation by becoming entangled in backstairs politics, which he does not understand simply because he despises it. He could serve the incoming President as disinterestedly and as efficiently as he served the outgoing President, but can he serve a senatorial junta?

A NEW method of flotation has been invented by M. B. Luckenbach, who started his investigations in San Francisco three years ago, but is now established at Brooklyn, New York. Accurate information is difficult to secure, but we learn that successful results have been obtained on various ores, notably in Utah. One interesting feature is the high recovery made in the treatment of oxidized ores, in which respect the new process is said to be superior to any heretofore known. The Canadian rights are reported to have been sold to Sir William Mackenzie, and a series of tests is now being made by the Ontario Bureau of Mines, at Ottawa. No special machine is required; both the Callow and Janney machines are quite suited to this new process, which makes a froth that functions well as a collector and is broken down more readily than the froth made by the use of oil. The only unfavorable feature of the story is the mystery in which the composition of the reagent is shrouded. We are told that it is not an oil, but everybody is not able to define what an 'oil' is, and in their enthusiasm to escape the clutches of Minerals Separation they are likely to give themselves the benefit of many scientific doubts. What is the difference between 'grease' and 'oil'?

THAT the U. S. Army gas-mask is not suitable for combating fires, in mines or elsewhere, is well known and warnings of this fact have been spread broadcast, but that the lesson has not been learned the fatalities at the Calaveras mine seem to prove. These lives will have been sacrificed in vain if attention is not directed to the fact, according to newspaper reports, that they were due to an attempt by men equipped only with masks of the Army type to enter workings filled with gases from a mine-fire. Mr. E. D. Bullard's letter, which we give on page 546, is to the point. He might have added two other sources of danger to the wearer of this type of mask. The Army mask is designed to absorb small amounts of poisonous gases and cannot furnish oxygen where it is lacking, as in combustion products. Gases from fires, as Mr. Bullard points out, contain large amounts of odorless carbon monoxide but they also contain small amounts of the pungent products of combustion, which serve as a danger-signal. The mask absorbs the latter but cannot absorb the large proportion of carbon monoxide; hence the wearer is deprived of the warning he otherwise would have had. The only value of the Army mask is as a protection against radiant heat.

GOVERNOR HARDING and Senator Harding are likely to be confused in the mind of the careless reader of a careless newspaper. The Governor of the Federal Reserve Bank occupies a position more important than that of the Senator from Ohio but less important than the one to which the Senator legitimately aspires. Mr. William P. G. Harding, the financier, is a man of perspicuous utterance, and we read his statements with much respect. He has been explaining that we have passed through "a period of exhilaration or intoxication" and that "business generally is looking forward to a bountiful harvest and better prospects for the railroads". In this time of belated deflation the Federal Reserve banking system of this country is playing the part of an admirable regulator. It aims to promote and assist the gradual and orderly marketing of the crops, so as not to involve too great a strain upon our transportation facilities and our mechanism of credit. The high discount rate prevailing at the Federal Reserve banks is meant to check too large a volume of re-discounts and to prevent an excessive reduction in the reserve of gold, which is nearly at the legal minimum. The power placed in the hands of the Federal Reserve Bank to moderate the issue of loans and thereby to curb profiteering has been used in salutary fashion. The fulminations of the Attorney General have been ridiculously ineffective in disciplining those who have made the most of the critical conditions created by the aftermath of the War and it is fortunate that the Government has another branch of administration that has been able both to protect the public and to regulate the use of capital for industrial activities.

FROM London we have received a copy of the register of old students and history of the Royal School of Mines. Although the graduates from this college of mining are few in the United States, this volume is interesting to Americans for several reasons. The School, called 'Royal' because the Prince Consort, Queen Victoria's husband, was its sponsor, dates from 1851. It was the child of the Geological Survey of Great Britain soon after it was founded by De la Beche, who became president of the School. The list of the first faculty is notable, for it included Lyon Playfair, Edward Forbes, Robert Hunt, John Percy, Andrew Ramsay, and Warington Smyth. In 1855 Roderick Murchison succeeded De la Beche. In 1854 Huxley joined the staff; and shortly afterward, Tyndall. Huxley became dean of the faculty, and remained the guiding mind of the institution until he retired, in 1885. It must be conceded that the School is rendered illustrious by its professorate; Victorian science gave of its very best to the Royal School of Mines, but the School never received the support that it deserved from a country for which mining, at home and abroad, has done so much. It was driven from pillar to post and tied to various grandiose but inchoate schemes of technical education, so that its identity was swamped and its usefulness crippled. Despite these unfavorable conditions it has won a recognized position among British colleges and has produced several generations of men prominent in the mining exploration and development to which the British empire owes its expansion. When the War came, the School was true to its best traditions; the classrooms were denuded of their students. The Roll of Honor includes 72 young men who gave their lives for

the cause of civilization. In war and in peace the Royal School of Mines has made good.

IN this issue we publish the first of a series of three articles that have appeared in 'The Annalist' of New York on the subject of 'Labor, the Holder of the Nation's Wealth and Income'. The writer of them is Mr. Walter R. Ingalls, for many years and until last year the editor of the 'Engineering and Mining Journal', a technical periodical of high standing. Mr. Ingalls is a keen student and a careful observer; therefore we feel sure that his conclusions on such an important subject will be read with interest and respect. He sets out to prove that labor now and for many years has won the lion's share of the wealth produced in the United States. In view of the facts brought out by him it will be well to note the data prepared by the Monmouthshire and South Wales Coal Owners Association, showing that since 1914 the item of wages in the cost of producing a ton of coal in the United Kingdom has risen from 6s. 2.92d. to 22s. 8.75d., while, on the other hand, the production of coal has fallen from 230 tons per man per year to 190 tons. Whatever the coal miner's wages, his share of the total wealth produced in the country is measured by the amount he has contributed toward increasing the country's wealth; in this case he is not doing as much in 1920 by 17% as he did in 1914, and therefore he is only entitled, on this line of reasoning, to 83% as much of food, clothes, comforts, and luxuries. His increase in wages can only mean one of two things: either he is obtaining, at the expense of workers in other industries, more of the country's wealth than that to which he is entitled, or the general rise in prices has been greater than the increase in his wages, in which event his bigger wages will do him no good. Obviously if the same conditions obtain in other industries, and probably they do, then the only preventive of hard times is greater efficiency of production. In the United States likewise the workman generally is less efficient than he was before the War and he is spending more. This means a decrease in the *pro rata* stored wealth of our people, not the store of dollars and cents represented by paper currency, bank credits, or shares of stock, but the wealth in bushels of corn or wheat and pounds of cotton or steel. During the War the loss of wealth due to under-production was compensated by the sale of munitions and supplies to Europe, but now no such compensating factor is at work and sooner or later we shall have to pay the piper unless our rate of efficiency in production is increased.

The Japanese in California

The question of Asiatic immigration to this State has become a matter of lively controversy by reason of the fact that the people of California at the election in November will vote upon an initiative measure to make more stringent the laws restricting the privileges of the Japanese to hold agricultural land. The Japanese are not mentioned in the Bill, but "aliens ineligible to citizenship" means Asiatics, and the Chinese having been excluded for many years, the intent of the proposed legislation is obvious. By an act of 1913 the legislature of California prohibited the owning of land by "aliens ineligible to citizenship", that is, Asiatics; and limited leases of agricultural land by them to a period of three years. Citizenship by naturalization is open, by Federal law, only to white persons and persons of African descent. The Chinese have been excluded from the United States by specific Federal act since 1882; the Japanese had been excluded from citizenship by judicial interpretation, until the Bureau of Immigration in 1911 ruled that a Japanese is not "a white person". It is claimed that the Act of 1913 has been evaded by the Japanese through the organization of corporations that acquire agricultural land, and by acquiring rights in the names of children born in California, and therefore both eligible to citizenship and entitled to own land. The measure that goes before the voters in California at the impending election prohibits the leasing or owning of agricultural land by aliens ineligible to citizenship; it prohibits such aliens from owning stock in corporations owning or leasing agricultural land; it prohibits such aliens from becoming guardians of that portion of the estate of minors which is agricultural land.

This is not the first time that California has shown her dislike of the Japanese. Until twenty years ago immigration from Japan was negligible; in 1899 only 2844 Japanese entered the United States; in 1900 the number increased to 12,635; in the year 1907 it reached 30,645. In that year, President Roosevelt, responding to urgent demands from California and other Pacific Coast States, and empowered by Congress to do so, issued an executive order denying entrance to Japanese laborers "who have received passports to go to Mexico, Canada, or Hawaii, and come therefrom". Concurrently the American and Japanese governments entered into the famous 'gentlemen's agreement' whereby the government of Japan agreed to cease giving passports to "laborers", except such as had been residents in the United States, or the parents, wife, or children of residents, and "settled agriculturalists". This agreement was observed effectively for a time; in 1909 only 3925 Japanese entered this country; after that a slight increase was recorded up to 1912, when 8589 entered; but since then the influx has gained in volume slowly until in the year 1919 it had risen again to 16,075. From all these figures for 'arrivals' it is necessary to deduct the 'departures'. Between 1902 and 1919 inclusive the grand total of 'arrivals' was 240,000, of whom fully half were transients, visitors to this country, and travelers to or from Europe. At the end of 1919 there were 87,279 Japanese in California, this being four-fifths of all of that race in this country. In a decade the total has doubled. These figures are issued by the State Board of Control and are subject to correction, but they are the only statistics available until the Census of 1920 is published. The people of our State have been told officially that the birth-rate among the Japanese is another menace; in ten years there was as much increase by birth as by immigration. Therefore they protested against the shiploads of 'picture brides', that is, the women selected by means of photographs and married by proxy to Japanese men in California. In consequence of

protests the Japanese government in February of this year made what may be called 'the ladies' agreement', whereby it promised to issue no more passports to 'picture brides'. The former Chinese immigration against which California protested so successfully was of men only, chiefly of coolies; the early Japanese immigration was likewise confined largely to male laborers; during recent years there has been a marked influx of women. It is complained that they and their children work in the fields with the men, thereby introducing another difference in the standard of living. By reason of their thrifty and industrious habits the Japanese are able to augment their holdings, establishing colonies, especially on irrigated lands, and competing successfully with American farmers. By subterfuge they evade the law that forbids them, unless born in the United States, to own land; they combine and co-operate; they are increasing in numbers and in property so fast as to attract the unfriendly attention of politicians looking for a popular cry. The coincidence of the Japanese crisis and the November election is significant. A good deal of the noise on the subject arises from the desire of politicians to curry favor with the classes that suffer by competition with the Japanese. However, there is real anxiety among thoughtful and fair-minded men lest the increase of the Japanese in California should prove injurious to this commonwealth, by introducing a large racial element incompatible with the American idea and prejudicial to our normal development as a white people. The question of inferiority or superiority of race does not arise; it is one simply of difference in traditions and ways of living. Politicians in Japan naturally express resentment against the proposal of the Californians to legislate against their emigrants. Twice a President of the United States has been compelled to send a member of his Cabinet to San Francisco to beseech the Californians to abate their impetuosity lest international trouble be caused. It seems to us that, as regards further Japanese immigration, the Japanese government should stop it, since it has been made clear that it is unwelcome. Of course, if the Japanese are to be debarred from California, they will have to be shut out elsewhere in this country, otherwise they will find their way hither. Presumably one nation can inform another that its nationals are not welcome. It is impolite, but it is better than ill-treating them when they arrive. All this refers, of course, only to the laboring class; it does not refer to Japanese merchants coming here to transact business or to Japanese students, scientists, and others of the educated class. They come as visitors, not as residents, and in any event it is not against them that popular prejudice has been aroused. Such an embargo on further Japanese immigration will be regrettable, from the standpoint of international courtesy, but it will be better than a recurrent squabble over the matter. As to the Japanese already here, their rights must be respected. To discriminate against them would be unjust and would give the Japanese government valid cause for serious complaint.

Whether some of the proposals in the initiative are contrary to the provisions of the Constitution of the United States is another question, which will be decided in due course, if necessity arise. The decision of the U. S. Supreme Court in the case of State of Missouri v. Holland, handed down on April 19, 1920, has a bearing upon the question of the power of the States in the matter of excluding foreigners or regulating their right to ownership of land as against a possible negotiation of a treaty by the Federal government on the subject. Some years ago Congress passed an act for the protection of migratory birds. That act was held by two Federal courts to be unconstitutional on the ground that it was a usurpation by Congress of powers that had not been granted to it and that had been reserved to the States. Subsequently a treaty was negotiated between this country and Canada providing for such protection of migratory birds. Congress thereupon, in order to enforce the provisions of the treaty, passed an act protecting from destruction these migratory birds. The power of Congress to do this was challenged by the States and it was claimed that Congress should be held to be without power in the matter and the act declared void for the same reason that the former act was declared void. It was held by three local Federal courts, however, and has now been held by the Supreme Court, that even though an act of Congress might be void if it attempted to deal with subjects belonging to the States, nevertheless, if the subject in question were a proper one for negotiation of a treaty with a foreign power and the treaty did not infringe any express provisions of the Constitution, it would be valid, and a law of Congress passed for the enforcement of that treaty would be valid, although the power to legislate upon the subject would otherwise have been reserved to the State. This was so held because of the provision of the Constitution that "all treaties made or which shall be made under the authority of the United States shall be the supreme law of the land", and that the subject of the protection of migratory birds was a national interest as to which the United States was not forbidden by the Constitution to act. Although the right to regulate or prohibit ownership of land by aliens may rest ordinarily with the States, it may well be held that this subject is a proper one for international agreement by treaty, and that if regulated thereby the treaty would control and the legislation of the States would be superseded. So far as existing treaties are concerned, they are expressly recognized in the proposed initiative measure, which provides that aliens ineligible to citizenship "may acquire, possess, enjoy and convey real property, or any interest therein, in this State, in the manner and to the extent and for the purposes prescribed by any treaty now existing between the Government of the United States and the nation or country of which such alien is a citizen or subject, and not otherwise". It is evident that the possible incidence of a later treaty is not ignored. Diplomatic action is inevitable, and most desirable. The people of California are fully entitled to express their opinion in a matter that affects them most immediately and the Federal government will undoubtedly give heed to their wishes in so far as they do not conflict with the larger interests of the Nation.

DISCUSSION

Advertising Ethics

The Editor:

Sir—The letter, which you print in your issue of September 18, from the Pennsylvanian manufacturer who implies that he will discontinue advertising in your paper unless you make your editorials politically Republican, instead of independent as they now are, reminds me of the good old-fashioned method formerly used in the mining region of northern Michigan to elect mine officials to local political service. The mine captain usually ran for the principal office. In the school-house, or wherever the voting was done, all the men who voted for the captain were lined up on one side of the room, and all who voted against him were lined up on the other. This enabled the captain to get a good look at those employees who opposed "normalcy". In case the opposition was numerous, the mine clerk could jot down the names. Either the captain was elected, or there was a big time at the mine the next day.

Evidently the Pennsylvanian manufacturer does not advertise in the 'New York Times', for I have not noticed that that prosperous paper has altered its editorials from their customary Democratic bias, although the advertising department is so deluged with business that several pages have to be refused each day because of lack of space. Likewise 'The World', which is fiercely Democratic, seems to attract all the advertising it can carry. The 'Evening Post', independent, apparently has not lost any ground by choosing to support Cox and Roosevelt. However, these papers undoubtedly would change sides if they knew that business and capital are supporting the Republicans.

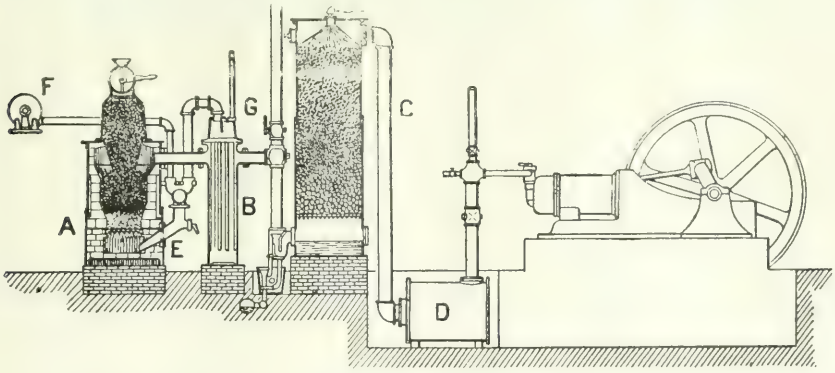
P. B. McDonald.

New York, September 24.

Two Suggestions on a National Problem

The Editor:

Sir—Your friend J. H. Curle, the well-known British mine-valuer, once said that it is safer to be on the pessimistic side of a problem than otherwise. I am that way inclined concerning the fuel problem for automobiles and stationary engines; evidently Mr. F. H. Mason, judging by his letter in the 'Press' of September 11, is not. I am quite aware of the intense search the world over for new oilfields, some of the results from such, the increase in American petroleum production, the possibilities of oil-shales, and progress in by-product coke-oven operation; yet we must not forget the enormous increase in the consumption of crude oil and its distillates. I did not suggest "anything approaching panic", as Mr. Mason says; nor did I hint at the "innate stupidity on the part of the Briton", quoting him again (that remark was quite uncalled for on his part, what does he mean?), the words "an unsightly bag atop of the machine" being Captain Brewer's phrase, or to that effect. There is one point where Mr. Mason is entirely incorrect: I did not suggest using producer-gas as a fuel for raising steam, only in internal-combustion engines. Carbon monoxide, the gas so produced, is made in a producer from any class of coal, coke, charcoal, husks of



SUCTION GAS-PRODUCER SYSTEM

A. Producer B. Evaporator C. Scrubber. D. Receiver E. Pipe for Water-Vapor from B F. Fan for Starting Fire in A G. Vent for Testing Gas

any kind, seeds, wood-waste, peat, sawdust, sugar-cane refuse, firewood, and such like, there being enormous quantities of waste in this country that could be so utilized.

There are two gas-producer systems, the pressure and suction. The former is more suitable for large power-units, and occupies more space than the suction system. In the pressure type, air required for generation of carbon-monoxide gas is used in the producer under pressure from an auxiliary source; but in the suction type, air is drawn through the producer by the piston of the gas-engine. Attention here will be paid to suction-gas power, and the accompanying sketch is almost self-descriptive.

Any of the fuels mentioned are fed into *A*, which has a feeder somewhat on the principle of the top of a blast-furnace. The fuel is lighted, and the fire urged for a few minutes by the fan *F*. The hot gas from *A* passes through *B*, which is practically a small water-tube boiler, producing steam for mixing with the air for making the gas in the producer. The first gas made is of poor quality, so until it is rich enough it is allowed to escape through the vent *G*. As the final gas from *A* is hot and dirty, it must be cooled and cleaned, so it passes through *C*. This is a steel cylinder filled with coke, over which water is sprayed, and as the gas passes through it, the heat and rust are abstracted. *D* is a receiver, gas-holder, or regulating tank between the scrubber and engine. If the fuel contains any tarry matters, an extractor consisting of a series of baffle-plates in a tank is placed in the circuit. When the engine is working, the piston sucks air and steam through the fuel, then the gas as made to the cylinder. After all is in order, the whole operation is automatic, save feeding fuel at regular intervals.

Mr. Mason appears to try to condemn producer-gas plants, and from his deductions engineers unacquainted with their operation would not be impressed with them; also, according to him, British and European practice has been inefficient for many years. (Crossley's in England has led in producer-gas plants for 40 years.) The thermal efficiency of suction-gas plants averages over 20%, up to 30%; while that of steam-plants is less than half of the higher figure. As for cost of operation, the gas plant leaves the steam-plant far behind. Mr. Mason must not forget that the very latest development in propulsion of motor vehicles, and adopted by the British government for Army trucks, is the Smith device that makes and uses producer-gas on the car itself.

M. W. VON BERNEWITZ

Sierra City, California, September 25.

Salting of Mines

The Editor:

Sir—Being a constant reader of your paper, I have from time to time noticed the articles under the title above given, and in the discussion column. I wish to mention three methods to which, as I remember, I failed to see any of your contributors refer. As all mining engineers will agree, both hand and machine powder is folded over carefully on each end. It follows that in the bulk-sampling or in making mill-test runs of ore in large mines it is possible for the ends of each stick of powder to be raised and a lot of the good old salt of the earth to be injected therein. Another way for hand-samples to be enriched is that in small mines or properties where limited development obtains, it is possible for the quartz or ore to be enriched in the following manner: The drilling of minute holes all over the exposed faces where an examining engineer would be likely to take samples, some chloride or virgin gold to be put into the holes prior to examination. I was told of a happening in Baker county, Oregon. Two engineers were to report at the same time. The first payment of $5000 depended on the assay-returns secured from the bottom of a forty-foot shaft. The engineers insisted that the drillings be saved from a complete round of holes. They stood and watched the miner all the time, and the method used was that the miner had a small bottle of virgin gold up one sleeve and would allow the gold to run down into the drillings.

Fields, Oregon, September 28. FRED. H. LORENZ.

Gas-Masks

The Editor:

Sir—In the face of the Calaveras Copper disaster, where two men lost their lives, because of the lack of knowledge that the U. S. Army gas-mask is worse than useless in fighting mine-fires, I think that your paper could do a good deal of educational work along this line.

Since the Armistice, the U. S. Bureau of Mines, the California Industrial Accident Commission, and the California Metal Producers Association have tried to bring to the attention of all mining men that in case of fire the only means of entering the same should be with an approved self-contained breathing apparatus and that gas-masks of the Army type should on no account be used.

Among the majority of ex-service men, who found the gas-mask a wonderful protection against the German gases, there arose a belief that the mask was the 'be all and end all' in the way of gas protection. But this tragedy at the Calaveras mine, sad though it is, should at last have the good effect of showing, once and for all, that this is not true and a mask should never be used. The U. S. Army mask was made for protection against war gases of which carbon monoxide could never be one, as it is lighter than air and would not stay on the ground. In the case of other gases, their density was quickly dissipated by the open conditions in which the gases were loosened and the percentage of gas was very small. In a mine-fire, carbon monoxide is the deadliest of all gases, and goes through the Army mask immediately, giving the wearer no protection. If other gases are present, they are so highly concentrated because of the confined condition of the mine that they would also go through the mask and poison the wearer. Therefore the only solution to the problem of fighting fires is to wear a self-contained breathing apparatus of the approved type and this cannot be too strongly borne in upon the mining world.

E. D. BULLARD

San Francisco, October 5.

THE UNITED VERDE SMELTER AT CLARKDALE, ARIZONA

The United Verde Smelter

By L. A. PARSONS

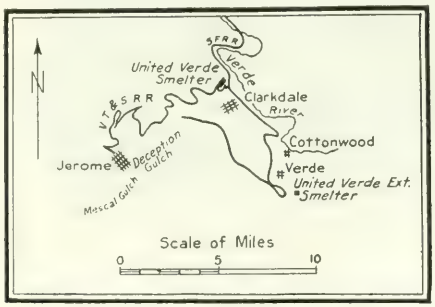
INTRODUCTION. The smelter of the United Verde Copper Co., at Clarkdale, Arizona, at the time of my visit in February was producing nearly 7,000,000 lb. of copper per month from 74,000 tons of ore, this, of course, being much below its capacity. Although working under restrictions as to output, and suffering, as are all industries nowadays, from excessive and rapidly shifting costs, the results that are being obtained compare favorably with the best that is being done in modern copper smelting. In particular, the blast-furnaces, in smelting 8.5 tons of charge per square foot of hearth-area, and in producing, from a 5.87% ore, a 25.7% matte with a coke consumption of 5.85%, are worthy of much more study than the time at my disposal permitted me to make. Costs[1] for January, a representative month, were, without credits, $1.84 per ton of charge for blast-furnace operation; $2.13 for reverberatories; $0.23 for Wedge furnaces; and $12 per ton of blister copper for converters. The total recovery for the same month was 88.54%. Considerable of this loss is in the stack-dust, and will be saved by a large Cottrell treater now designed and authorized.

During this period of reduced production the management is proceeding with the enlargement of the smelter. The present plans call for a plant capable of producing 12,000,000 to 15,000,000 lb. of copper per month when the market warrants, the ore for this to come from steam-shovel work in the fire-zones of the mine. The increased smelter capacity is to be obtained by doubling the number of roasting and reverberatory furnaces, the blast-furnaces remaining the same. This will also double the power to be obtained from waste-heat, giving a total of 8400 boiler horse-power from this source. The increased ore-tonnage will require a new crushing-plant, which will be erected at the smelter. This will supersede the present one at the portal of the Hopewell tunnel. It will be of the type used at the steel mills, that is, stock-piles and gantry-cranes, and will have a storage capacity of 250,000 tons. Another innovation is coal-dust firing of the reverberatories to supersede the present system of oil-firing. The new plant for preparing the coal-dust is nearly completed, and has many interesting features of design. Mr. Tally informs me that one lack which for a

[1] I cannot avoid commenting upon the extraordinarily liberal policy of the management with regard to giving out costs, charges, and other information that most companies guard jealously, and I must express my appreciation of the exceptional facilities extended to me. It is not practicable here to thank in person all those who courteously assisted me in my study of the plant and its operation, but I wish especially to acknowledge my indebtedness to R. E. Tally, the assistant general manager for the United Verde Copper Co.; to Tom Taylor, the smelter superintendent; to C. R. Kuzell, the assistant smelter superintendent; to C. M. Hoffman, the superintendent of machinery; and for many valuable statistics on ore production to H. DeWitt Smith, the superintendent of mines.

long time has been felt at the smelter is a suitably equipped research department, and plans are now under way to remedy this. One of the first problems of the new department will be the recovery of the zinc in the flue-dust.

Clarkdale, the site of the smelter, is a 'company' town that shows, in its well-ordered streets, attractive dwellings, and a modern hospital, a concern for the welfare and contentment of the employees that is worthy of the best traditions of the mining industry. It is situated in the Verde valley at an elevation of 3560 ft., four miles north and 1700 ft. below Jerome, the principal business centre of the mining district and the operating headquarters of the United Verde mine. Communication with the outside world is maintained by the Verde Valley branch of



THE RAILROADS OF JEROME

the Santa Fe railroad, which connects with the Ash Fork-Phoenix line at Cedar Glade. The ore is brought over the Verde Tunnel & Smelter railroad, which connects Jerome with Clarkdale. Limestone for flux is shipped over the same road from a quarry close to the right-of-way.

This railroad, which is new, is a subsidiary of the United Verde Copper Co. The ore is loaded at Hopewell, a crushing-plant and loading-station at the portal of the main adit, which taps the United Verde mine at the 1000-ft. level. From the station at Jerome to Clarkdale is 10.7 miles by railroad, a drop of 1700 ft.; from Hopewell to Clarkdale is 6.7 miles and a drop of 940 ft.[2] The road is of standard gauge and will eventually become the main line to Jerome, superseding the present narrow-gauge and tortuous tracks connecting Jerome with Jerome Junction. Although a great improvement over the older road, the almost precipitous drop of the mountains to the Verde valley rendered its construction no simple problem, and it is essentially a mountain railroad. The grade is compensated 4% for its entire length; the longest tangent is 800 ft., and the maximum curvature 24°. Ninety-pound rails were used. At the time of my visit the ore-trains were being hauled by locomotives with cylinders 21 by 26 in., 164,000 lb. on drivers; but as these could haul only 200 tons up the 4% grade, they were being replaced by Mallet locomotives, which are expected to haul 600 tons or 27 empties. These locomotives have 376,000 lb. on the drivers. The ore-cars are steel 60-ton bottom-dump of 1228-cu. ft. capacity, built by the Pressed Steel Car Company.

Classes of Ore. The ore as mined is divided into four classes according to its chemical characteristics, which dictate different methods of treatment or use at the smelter. The mining of the ore has recently been covered exhaustively by an able and comprehensive paper to be presented at the Lake Superior meeting of the American Institute of Mining Engineers in August,[3] to which the reader is referred for further details; here only sufficient will be given to enable the metallurgist to understand the problem that must be solved by the smelting department. The names applied to these classes of ore—'oxide', 'iron', 'silica', and 'converter'—have been in local use for many years, and some of them are now misnomers, as will be seen from the descriptions and analyses. The bulk of the tonnage consists of the iron and silica ores.

Oxide Ore. This is a small tonnage, less than 3% of the total, mined from the oxidized zone above the 160-ft. level. A small amount of primary sulphides is present, but in general the copper content is low.

Iron Ore. This comes from stopes within the massive sulphide areas of the mine, and contains the highest copper content of the four classes. Ore from these stopes containing 15% or more of silica is classed as 'silica ore' and is diverted to the silica ore-bins.

Silica Ore. The ore from all black-schist stopes and from porphyry stopes assaying less than 50% total silica is classed as silica ore, together with the ore from the sulphide stopes containing more than 15% silica. It will be noted that this name is particularly misleading, as the iron is often in excess of the free silica and most of the silica is combined with alumina.

Converter Ore. This is a high-silica low-copper ore mined in the quartz-porphyry, and is used for flux in converters and for fettling reverberatories. A small ton-

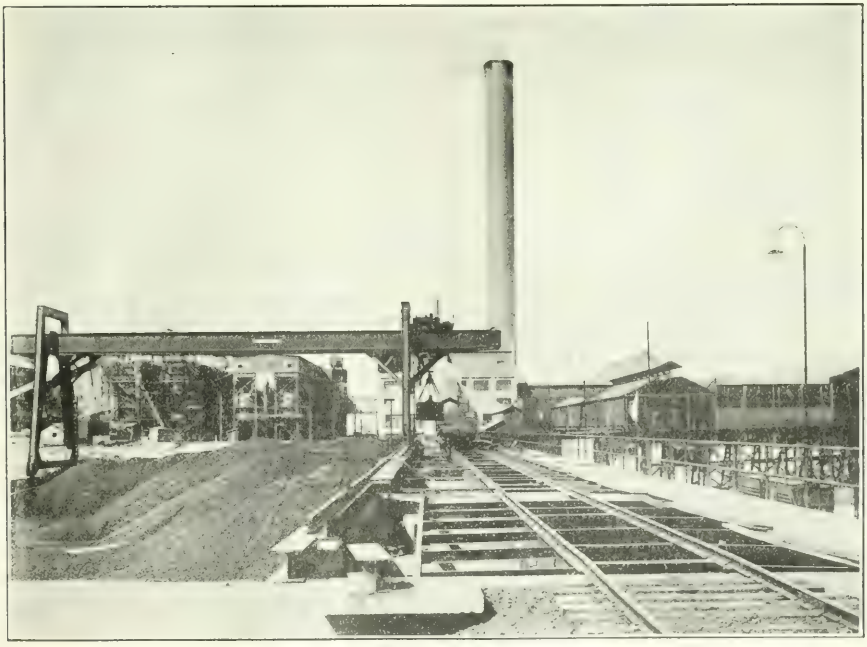
[2]Jerome is built on the side of a mountain, and different parts of the town differ greatly in elevation. The surface of the mine is several hundred feet higher.

[3]'Mining Methods and Costs at the United Verde Mine'. By H. DeWitt Smith and W. H. Sirdevan. Bulletin A. I. M. E., May 1920.

Ore Shipped to Smelter in 1918

Class	Tons	Proportion of total shipments	Copper	Gold	Silver	Iron	Insoluble	Silica	Alumina	Sulphur	Zinc
		%	%	Oz.	Oz.	%	%	%	%	%	%
Oxide	[illegible]	2.59	1.42	0.025	8.37	30.9	39.2	34.1	5.7	2.6	0.1
Iron	[illegible]	49.10	6.14	0.025	1.94	31.6	13.61	8.8	3.3	34.9	2.3
Silica	341,749	37.65	5.05	0.025	2.06	24.1	26.9	19.3	10.4	19.4	1.1
Converter	91,379	10.62	2.06	0.061	2.32	9.1	73.7	67.0	9.9	4.6	0.3
Precipitate	325	0.04	65.45			4.3	1.8	1.3	2.9	1.0	0.6
Total	861,780	100.00	5.20	0.034	2.19	27.6	33.6	19.6	6.75	26.8	1.77

THE OLD SMELTER AT THE MINE



THE NEW SMELTER AT CLARKDALE

nage is mined from stopes near the contacts with the sedimentary schist, but the main supply comes from a large secondary-enrichment orebody situated some distance from the main orebodies.

In addition to these four classes, a small amount of precipitate is recovered from the mine-water. The table on page 548 gives detailed assays and tonnages for each class produced during 1918.

It has been calculated by the staff that these assays correspond to the following mineralogical composition:

Mineralogical Composition of Ore Shipped to Smelter

	Proportion contained in various ores			
	Oxide	Iron	Silica	Converter
	%	%	%	%
Pyrite	5	59	28	5.75
Chalcopyrite	..	18	16	1.00
Sphalerite	..	4	2	0.50
Chalcocite	2	..	..	1.50
Cuprite and carbonates, native copper	..	..	..	0.25
Cuprite	1	..	..	....
Sulphates and carbonates of iron, copper and lime	3	..	..	....
Iron oxides	46	2	2	11.00
Ferruginous chlorite	..	..	38	6.00
Quartz	28	5	5	54.00
Silicates (sericite, hornblende, kaolin, etc.)	15	10	9	20.00
Calcite and siderite	..	2	..	....
Total	100	100	100	100.00

Distribution of the Ore. The oxide ore is usually wet and sticky, and goes direct to the blast-furnaces without preliminary crushing. The converter, silica, and iron ore all go through the crushing-plant at Hopewell. This is an old plant and at present is considered by the staff to be more or less of a makeshift, pending the construction at the smelter of a new plant embodying modern principles of design. At Hopewell all ore except the oxide is crushed to 4 or 5 inches by a No. 9 gyratory and screened over 1½-in. square holes. The oversize of the silica and iron ore is the main blast-furnace feed. The oversize of the converter ore is re-crushed at the smelter and is used for flux in the converters and reverberatories. The size to which this is crushed varies from time to time owing to the present inadequate crushing facilities. The size that has been found by the smelter staff to be most suitable is about that of ordinary marbles with the dust removed, but this cannot always be obtained with the present equipment. When the new plant is in operation all the converter ore will be crushed to this size.

The converter, silica, and iron ore, after going through the 1½-in. square holes, is re-crushed at Hopewell by two 48-in. vertical Symons disc-crushers, one of which is kept as a spare, and by four 54 by 24-in. rolls to pass a $\frac{7}{16}$-in. round hole, and thence goes to the roasting-furnaces. This size also leaves much to be desired, but it it the best that the present plant will do. The pyrite in the ore is an extremely hard massive variety, and its physical properties are such that, when as coarse as half an inch, it will not roast well in the ordinary time of travel through a roasting-furnace.

There are two bins for ore at the smelter, each with a capacity of 14,000 tons, giving a total storage of 28,000 tons. The bins over which the entering tracks pass are used principally for coarse, only two compartments being reserved for fine. The other bins are used for the storage of fine, which is transferred by belt-conveyor and elevator from the two receiving compartments. The chutes under the coarse bins discharge into weighing-hoppers, each of which will hold approximately three tons of iron ore. The charge, weighed and ready when the charge-train runs under the bins, is thus quickly tripped into the cars. The fine, however, is measured by a different method; instead of discharging into weighing-hoppers, it is run through calibrated gates onto 30-in. belt-conveyors. These gates are opened to a width giving a fixed number of tons per hour, so that mixtures containing the desired proportions of different types of ore are made directly on the belt. The charge is elevated to the roaster-bins by a 20-in. belt-conveyor at an angle of 15°. All the charge goes to the roasters on the day-shift, and in order to continue this practice, when the heavy tonnages from steam-shovel operations[4] start to come in, the 20-in. belt will be replaced by one 30 in. wide. As soon as the roaster-charge has been made up, an underground conveyor diverts the fine to the elevator leading to the fine-storage bin.

Roaster Plant. The present roaster plant consists of twelve 21½-ft. 6-hearth Wedge furnaces with an additional drying-floor, driven by a 35-hp. motor. Twelve additional roasters are being erected to handle the steam-shovel tonnage, each 22½ ft., with 7 hearths, an extra hearth being substituted in place of the drying floor because the compact structure of the sulphides requires more time in the furnace than the present type permits. An unusual feature of all these furnaces is that they revolve on roller-bearings running in oil. Even with the restricted production at the time of my visit the present roaster plant was badly crowded, the figures for January showing an average of 93.2 tons per furnace-day, against a rated capacity of 75 tons. Forcing the roasters to such an extent required the use of 1725 bbl. of fuel-oil, an average of 4.7 bbl. per furnace-day. This expense will be obviated when the additional roasters are in operation.

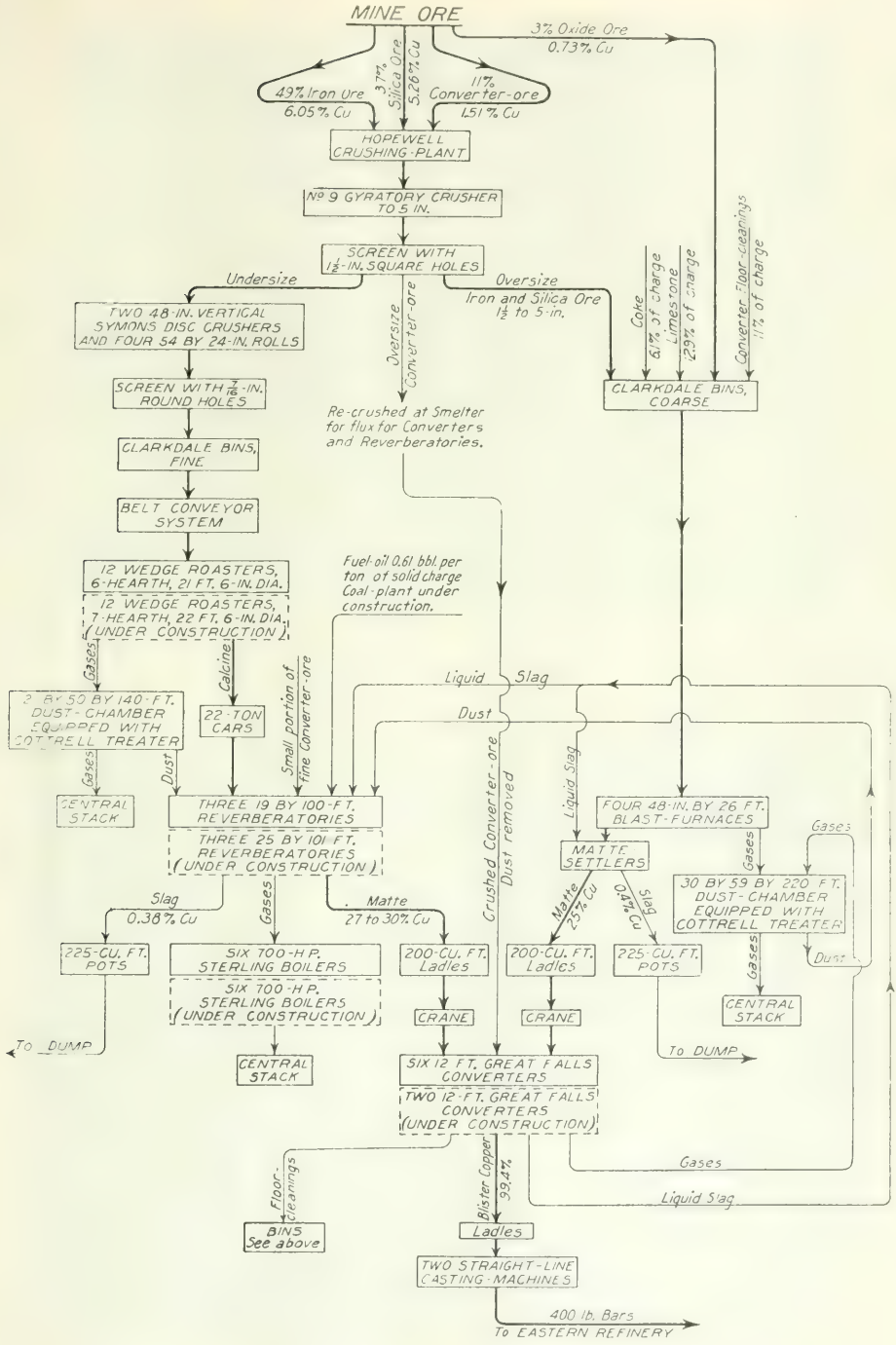
The fume from the roasters discharges through a dust-chamber 50 ft. wide, 21 ft. high above the top of the hoppers, and 140 ft. long, into the central stack, which is 30 by 400 ft., made of self-supporting steel and lined with Gallup brick. A 20-ft. section in the middle of the dust-chamber has wires hung at three-inch centres, but these are being superseded by an agglomerator type of the Cottrell process, known as the Frisbie modification.

The calcine is hauled to the reverberatories in cars holding 22 tons, by 10-ton electric locomotives, driven by 250-volt D.C. motor.

The statistics on roaster operation for January are as follows:

	Tons charge	Copper, %
Converter ore	4,400	1.51
Silica ore	13,965	5.26
Iron ore	15,905	6.05
Total	34,269	5.15
Calcine recovered		28,649
Shrinkage, tons		5,620
Shrinkage, per cent		16.40
Furnace-days		367.56
Tons charge per furnace-day		93.2

[4]These steam-shovel operations at the mine will be described in a succeeding article.



FLOW-SHEET OF THE UNITED VERDE SMELTER

Costs for the same period are as follows:[5]

	Per ton of charge
Belt-conveyors	$0.03
Fuel-oil (crowding roasters)	0.12
Operating	0.07
Unclassified	0.01
Total calcining per ton of charge	$0.23

THE REVERBERATORY PLANT in present use consists of three 19½ by 100-ft. oil-fired furnaces, with a rated capacity of 650 tons of solid charge plus 120 tons of converter slag per day. Like the roaster plant, this department is being enlarged by the construction of three more furnaces, each 25 by 100 ft. The furnaces now in use are ample to take care of all the calcine that can be put through the present roasters. The lining is ordinary silica brick, except around the tap-holes, where chrome brick is used. The roofs are ribbed similarly to those at Anaconda. The length of campaign with the 19½-ft. furnaces is about 100,000 tons without patching the roof; it is expected that the new furnaces will handle 150,000 tons.

The gases from each furnace pass through two B. & W. Sterling 700-hp. boilers, making six in present use and six more to be constructed with the new furnaces. In addition, two similar furnaces are direct-fired by oil-burners. The steam is carried to the power-house in a double 10-in. header.

The matte is tapped near the uptake or flue end of the furnace and in order to avoid the use of long launders to convey the matte to the converter-aisle a tunnel has been constructed between each pair of furnaces and at right angles to the aisle. The matte is tapped into a ladle, which is carried on a small truck in the tunnel. After delivery to the converter-aisle on this small truck the 200-cu. ft. matte-ladle is carried by crane to the converters. The slag from all the furnaces is hauled to the dump in 225-cu. ft. electric-tilted slag-pots by an 18-ton electric locomotive.

The statistics on reverberatory operation for January are as follows:

	Tons	Copper, %
Converter ore (fettling)	504	1.51
Calcine	28,649	6.40
Blast-furnace flue-dust	1,338	14.80
Roaster-dust	1,577	6.30
Total	32,068	6.67
Furnace-days		62
Tons per furnace-day		517

In addition to the ore-tonnage, approximately 120 tons of liquid converter-slag is charged per day.

	Bbl.	Bbl. per ton of solid charge
Fuel oil	19,484	0.61
Credit waste heat	6,819	0.21
Balance charged to reverberatories	12,665	0.40

The matte ranges from 27 to 30% copper and the slag averages 0.38% copper and 36% silica.

Costs for the same period are as follows:

	Per ton charged
Tramming and weighing	$0.09
Fuel-oil	1.54
Operating	0.39
Slag removal	0.07
Unclassified	0.04
	$2.13
Waste-heat credit	0.54
Cost without calcining	1.59
Calcining per ton reverberatory charge	0.25
	1.84
Credit smelting blast-furnace flue-dust	0.08
Net cost reverberatory smelting	1.76

Fuel-oil costs $2.53 per barrel f.o.b. smelter. All reverberatory furnaces are being equipped for pulverized coal. The coal plant is described later in this paper.

BLAST-FURNACE PLANT. There are four blast-furnaces, each 48 in. by 26 ft., with 48 tuyeres of 4¾ in. diameter. A feature of these furnaces that is rather a novelty is the Giroux hot-blast top, by means of which the blast is heated to 100° or 150° above the atmospheric temperature. No research has been done to determine the exact effect of this; it has been in use a long time, and is considered by the smelter staff to be beneficial. The blast-pressure varies from 22 to 40 oz., depending on the capacity desired. No pulverized coal has yet been blown through the tuyeres, but the management expects to undertake experiments with this process. The fume discharges into a dust-chamber 220 ft. long, 59 ft. 2 in. wide, and 29 ft. 6 in. high above the hoppers, but when the Cottrell plant is completed the fume will pass into it. The matte is tapped directly into 200-cu. ft. ladles in the converter-aisle, and the slag is hauled in 225-cu. ft. slag-pots. Liquid converter-slag was formerly dumped into the settlers, but with the exception of an occasional ladle it now all goes to the reverberatory furnaces.

The statistics on operation for January are as follows:

	Tons	Copper, %
Silica ore	12,932	5.26
Iron ore	18,530	6.05
Converter ore	41	1.51
Oxide ore	2,472	0.73
Swansea lease	562	22.86
Total ore	34,537	5.64
Limestone	5,862	...
Smelter cleanings	4,988	...
Total charge without coke	45,387	5.39
Furnace-days		61.8
Tons per furnace-day		734
Tons per square foot of hearth-area		7.06
Coke		6.1%

The matte averages 25% in copper and the slag 0.4%.

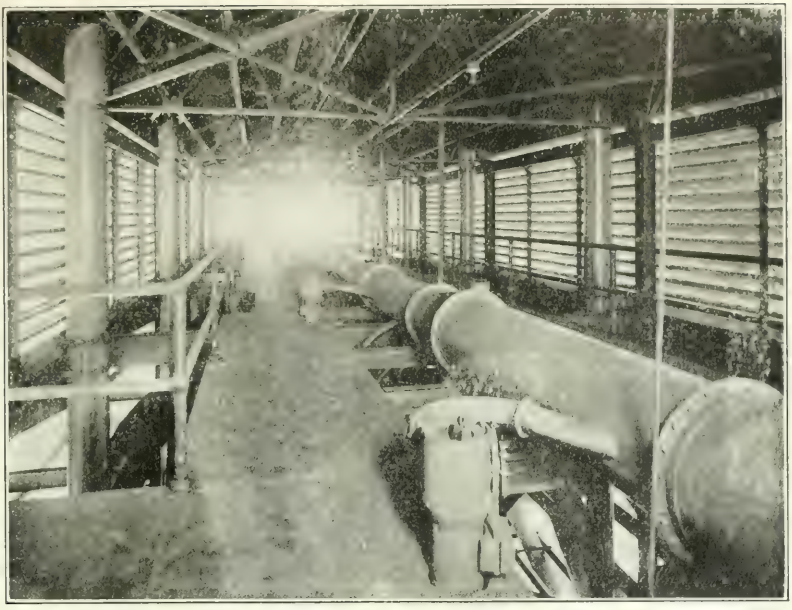
Costs for the same period are as follows:

	Per ton charged
Tramming and weighing charge	$0.09
Coke	0.93
Air	0.24
Operation	0.30
Flux	0.10
Slag removal	0.07
Unclassified	0.05
	$1.78
Reverberatory charge for flue-dust	0.06
Total per ton of charge	$1.84

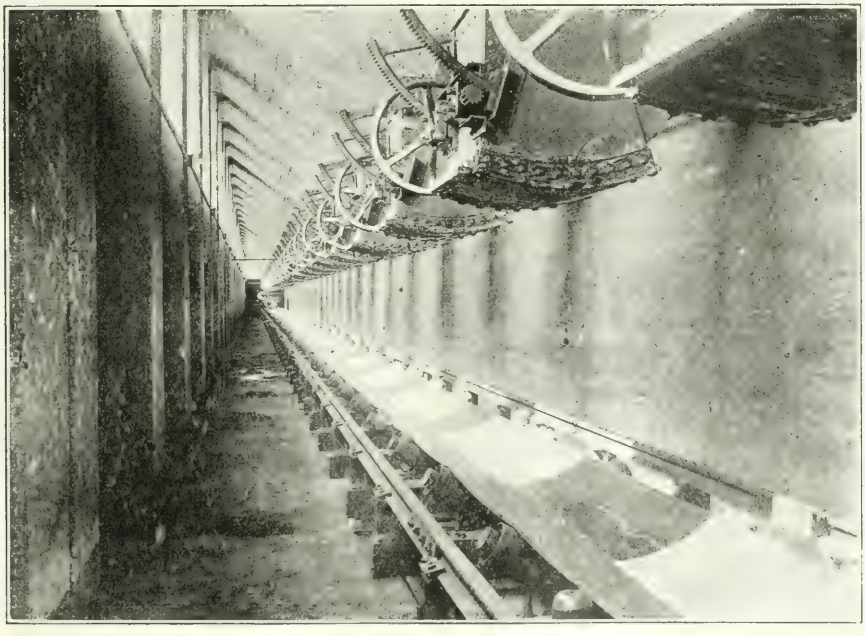
Coke cost $15.32 f.o.b. smelter during this period.

The smelter staff is engaged in increasing the efficiency of the blast-furnaces. Considerable improvement has been made in comparison with former practice, but it has not yet been determined just what results can be

[5] All costs given in this article, both for this and other departments, are for operating and repairs; they include no overhead nor supervision above the grade of shift-boss.



VACUUM HEADER IN COAL-PULVERIZING PLANT



GATES AND CONVEYOR UNDER COAL-STORAGE BUNKERS

obtained. The best result so far obtained was in March, the record for which is as follows:

Tons per furnace-day	908.4
Tons per day per square foot of hearth-area	8.5
Coke per ton of charge	5.85%
Coke per ton of cupreous material	6.48%
Copper in charge	5.87%
Copper in matte	25.7%

Although this record is gratifying, the smelter officials have hopes of doing even better, particularly in cutting down the proportion of fuel. Some runs have been made with 4.5% coke, but so far not for a continuous month.

A study of the figures of cost will throw an interesting side-light on the controversy over the relative merits of the blast-furnace and the reverberatory. Giving credit for waste-heat, the cost of reverberatory treatment, including calcining, for the month under consideration is $1.84 per ton of charge, exactly equal to that of the blast-furnaces, which must pay for having their flue-dust smelted. The blast-furnaces, however, were being operated at capacity and the reverberatories were not, which throws this comparison somewhat in favor of the reverberatories, although the cost of the finer crushing necessary before calcining is not included. As these costs are so nearly the same, the attitude of the management is significant. At present some ore of blast-furnace size is being crushed in order to smelt it in the reverberatories, and with the completion of the new reverberatories this will be still more the practice. It is planned at that time to make any necessary curtailment of output, as market conditions fluctuate, by shutting down blast-furnaces and smelting a larger proportion in the reverberatories.

Without the waste-heat credit, the reverberatory and calcining cost is $2.38, a result that, at this plant, would have thrown the argument strongly in favor of the blast-furnace. Thus the waste-heat here, as in most of these comparisons, is seen to be the critical factor. Water-power in Arizona is scarce; hydro-electric plants are few; a large part of the electric power used over the State must be generated by steam, and this is expensive. The United Verde pays from 1 to 1¼c. per kw-hour to the Arizona Power Co. for the excess power it may require. This high rate for power makes waste-heat exceedingly valuable; practically the entire power-plant is run by it, and a waste-heat credit of 54c. per ton of charge is the result, an advantage that no blast-furnace could hope to overcome on other than the most refractory ore. Although somewhat of a digression, it may here be noted that at the time of my visit to the United Verde Extension smelter, which will be described in another article, only the reverberatory was being operated, the same condition of expensive power causing the management to meet a necessary reduction of output by shutting-down the blast-furnace.

This condition of expensive power, however, does not exist where hydro-electric energy is available. Companies owning their own hydro-electric plants and delivering ample power cheaply, find that the waste-heat credit from their reverberatories dwindles to a few cents; the comparison is made almost purely on operating characteristics, and at many places a preference for the blast-furnace is the result. The Sudbury district is an example of this kind, the greater part of the smelting there being done in blast-furnaces, although even there the comparison is a close one, and much of the preference for the blast-furnace is undoubtedly due to the momentum of existing practice. Where waste-heat cannot be used economically for power, its re-use in the reverberatory is the only alternative. All methods so far developed for doing this rely on some form of the regenerative checker system, and metallurgists seem to have a strong aversion for the cumbersome plant required and the operating difficulties introduced by the necessary reversal of gases.

Converter Plant.—There are six 12-ft. basic converters of the Great Falls type, of which five were in operation. Two more stands are under construction. The lining is magnesite brick 15 in. thick. Each converter has 16 tuyeres of 1½ in. diameter. These are double, containing an inner pipe that can easily be replaced. The air-pressure averages 14 lb. The converters are tilted by Allis-Chalmers 50-hp. motors, 440 volt, 65 amp., 60 cycle, acting through a steel worm turning a 70-in. brass gear. As the brass wears it is removed from the spider and a new one substituted. Since power is on tap from two sources, the United Verde power-plant and the Arizona Power Co., and the converter air is furnished by steam-operated units, there is no danger of freezing the tuyeres.

As previously noted, the matte is transferred to the converters, from both reverberatories and blast-furnaces, by 200-cu. ft. ladles. Flux is fed by gravity through spouts leading from overhead bins, which in turn are kept supplied by a belt-conveyor. The matte is blown to 99.4% blister, which is carried by ladles to two straight-line casting-machines, and cast into 400-lb. bars, which are shipped East to be refined. As much slag as the reverberatories can handle is treated by them, the excess going to the blast-furnace settlers; and this has been reduced to only an occasional ladle.

The cost of converting in January was $12 per ton of blister copper.

Pulverized-Coal Plant. In taking up the mechanical equipment, those vital accessories on the smooth working of which the very life of a smelter depends, perhaps the most interesting department is the new plant, not yet completed, for treating the coal to be used in firing the reverberatories. This plant is particularly interesting, not so much because this method of firing reverberatories is comparatively new, but because it represents a most recent decision of the management as to the apparatus and arrangement best fitted to meet its needs. When this plant is completed, coal-dust will displace the oil now used for firing the reverberatories.

The coal as it comes into the smelter-yard will be stored under water in two concrete open-top bins holding together 15,000 tons. An Alliance Machine Co. gantry-crane with a 2½-yd. clam-shell bucket serves these bins, filling them from the railroad cars, and transferring coal as needed into smaller bins feeding a belt-conveyor system. The first belt-conveyor is 36 in. wide; at the end of

the bins it rises at an angle of 15°, dropping the coal into the primary breaker, which is driven by a 50-hp. motor. From the primary breaker the coal drops onto another belt-conveyor, which carries it to the dryer-building. This is equipped with two Ruggles-Coles A14 coal-dryers, each driven by a 200-hp. motor. Space is provided for the erection of a third dryer, if it is found to be necessary. From the dryer-building the coal passes to two Jeffries coal-disintegrators, thence by bucket-elevator to the bins in the pulverizing-building. Space is provided for a third disintegrator. From the bins in the pulverizer department the fine coal drops into eight 5-roller Raymond impact-pulverizing mills. The blowers main-

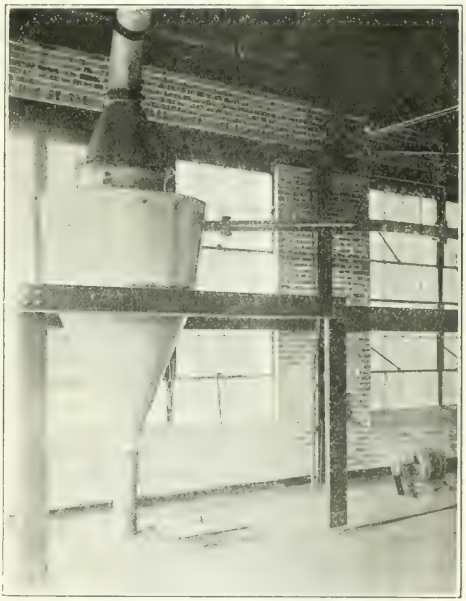
TOM TAYLOR, SMELTER SUPERINTENDENT, UNITED VERDE COMPANY

tain a 16-oz. air-suction at the top of each mill, and the coal stays in the mill until it is fine enough to be lifted by this current of air. From the mills the suction carries the coal-dust to a 16-in. screw-conveyor, by which it is conveyed to a 60-ton bin in front of each reverberatory. Firing will be done through five burners for each furnace.

In the general arrangement of the entire coal-plant, and its relation to the reverberatories, every precaution has been taken against fire and explosions. The dryer and pulverizer buildings are built of brick and concrete on a steel frame, and are conspicuous for the ample space provided, the large windows, and the amount of ventilation. There is no crowded machinery and there are no awkward angles to catch coal-dust. The conveyors and other necessary apparatus are so arranged that the floors can be flushed easily with water and the accumulation of coal-dust reduced to a minimum.

Since the writing of this article the coal-plant has started operations and has been found to be remarkably free from dust.

THE POWER-PLANT. The factors influencing the design of the power-plant were expensive power, the need for auxiliary units for generating electric current when the lines of the Arizona Power Co. failed, and a large supply of steam from the waste-heat of the reverberatories. With three reverberatories in operation this amounts to 4200 boiler horse-power; with the completion of the new reverberatory plant this will be doubled. Most of the blowers and compressors are driven by steam, but some



COAL-DUST COLLECTORS IN DRYER PLANT

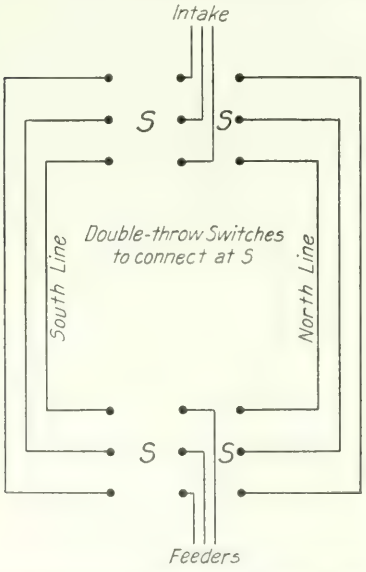
are electrically driven, as will be noted in the list of equipment, and one stand-by blast-furnace blower is driven by Diesel engines. The high cost of power dictated several refinements, for the controlling of waste, that would not be worth while at a plant where power is cheaper. Among these is the separation of the circuits in all the important buildings into a day system and a night system. In the day-time a few lights are always needed for dark corners, and also outlets for extension cords. These are all on a 'day' circuit. The great bulk of the lights, which are required only at night, are on a 'night' circuit. These two circuits are separated at the main junction-box for each building; when the foreman for day-shift comes on duty he opens the 'night' circuit, thus preventing useless waste of current irrespective of what is done with the individual switches.

Another detail of design that has saved many operat-

ing delays and other more serious trouble is a system of double power-lines. To all the individual important circuits in the plant, such as converters, cranes, and transportation systems, two power-lines are run, one around the north end of the plant and one around the south end. These two lines are tied to the intake and the feeders by double-throw switches, as indicated on the accompanying sketch. In case of trouble on the operating line the man in charge does not delay to discover the trouble; he merely throws the two sets of double-throw switches, a matter of a few minutes only, operation is resumed, and the trouble is hunted down at leisure. H. A. Reutschi, chief electrician, stated that this system has been found invaluable, and that it has saved many times the cost of the double installation. When the Arizona Power Co. lines go, the United Verde turbo-generator sets take the load.

To aid in obtaining quick attention to trouble, all stations for electricians are on an individual telephone system direct to the electrical shop, where some one is always on duty. The shop has a telephone switch-board and the operator can act as 'central' to connect the electrician's stations, either with each other or with an outside line. Trouble is telephoned to the electrical shop by the shift-boss or foreman, where the man in charge, who has a chart showing the position of every electrician at that moment, calls up the most available man and sends him to attend to the work.

The switchboard in the power-house is of the 'remote control' type. On the main floor is the polished slate



ARRANGEMENT OF DUPLICATE POWER-LINES

board of 39 panels, wired for 2500 volts. The levers on this board are mechanically connected to oil-switches on concrete panels in the basement. As is customary the oil-switches are protected by disconnecting knife-switches, to safeguard doubly men working on the line, or in case the oil-switches need repairing.

The air for the blast-furnaces is furnished by the following equipment, at an average pressure of 31 ounces:

Electric drive:

One No. 11 Root blower, 48 by 132, rated at 401 cu. ft. per revolution to 2½ lb. Driven by one G. E. 500-hp. induction motor, type 1-16-500, 2200 volt, 442-450 r.p.m. Gear-connected.

One No. 11 Root blower 48 by 99, rated at 300 cu. ft. per revolution. Driven by two motors, each Westinghouse 200-hp. induction, type CCL, 440 volt, 254 amp., 495 r.p.m.

One No. 9½ Root blower, 48 by 99, rated at 224 cu. ft. per revolution. Driven by one Westinghouse slip-ring induction motor, type CW, 2200 volt, 585 r.p.m.

One No. 11 Root blower, 48 by 132, rated at 400 cu. ft. per revolution. Connected by rope-drive to one Westinghouse slip-ring induction motor, type SP, 2200 volt, 315 r.p.m.

Steam drive:

One No. 11 Root blower, 48 by 132, rated at 400 cu. ft. per revolution. Direct-connected to an Allis-Chalmers Corliss 16-32 by 36 cross-compound horizontal condensing engine. Steam at 150 pounds.

Diesel-engine drive:

One No. 11 Root blower, 48 by 99, rated at 300 cu. ft. per revolution, connected by rope drive to two vertical Diesel engines, triple cylinder type, 16 by 24 in., 225 hp. each. This blower is kept as a spare. Air for the Diesels is furnished by two Ingersoll-Rand three-stage compressors, 8-5-2⅜ by 8, 185 r.p.m., compressing 86 cu. ft. of free air per min. to 1200 lb. The starter and the compressor drive is a Westinghouse 50-hp. slip-ring induction motor, 2200 volts.

The air for the converters is furnished by the following equipment, at an average pressure of 16 lb. All are steam driven.

Nordberg blowing-engine, horizontal cross-compound condensing duplex. Steam end 60-28 by 48. Uses steam at 175 hp. with 100° super-heat. Air end 60-60 by 48. Capacity 24,000 cu. ft. of free air per min. at 81 r.p.m. Fly-wheel 60,000 lb., 18 ft. diameter.

Nordberg blowing-engine, horizontal cross-compound duplex. Steam end 32-64 by 54. Uses steam at 120 lb. Air end 60-60 by 54. Capacity 20,000 cu. ft. of air per min. at 56 r.p.m.

Southwark blowing-engine, horizontal cross-compound duplex. Steam end 28-52 by 60. Steam at 125 lb. Air end 60-60 by 60. Capacity 20,000 cu. ft. at 60 r.p.m.

Southwark turbo-blower, Rateau-Smoot type, water-cooled. Steam at 125 lb. Capacity 25,000 cu. ft. at 2500 r.p.m.

General high-pressure air is furnished by:

Ingersoll-Rand two-stage compressor, Class PRE 2, 29-17½ by 21. Capacity 2470 cu. ft. of free air to 100 lb. at 180 r.p.m. Direct-connected to a G. E. self-starting synchronous motor, 2200 volt, 180 r.p.m., 434 brake horse-power.

Nordberg compressor, steam driven, two-stage cross-

compound condensing. Steam end 22-42 by 48, Corliss type. Steam at 100 lb. Air end 19-32 by 48. Capacity 2500 cu. ft. of free air to 90 lb. at 57 r.p.m.

There are two generators, driven in parallel, to furnish current for all purposes when the lines of the Arizona Power Co. fail, namely:

One Allis-Chalmers 2000 kw. turbo-generator, Parsons type, condensing. Steam at 150 lb., 2300 volt.

One Allis-Chalmers 1500 kw. turbo-generator, Parsons type, condensing. Steam at 150 lb., 2300 volt, 3600 r.p.m.

All AC machine fields are excited by

One Allis-Chalmers turbo-exciter, 125 volt, 280 amp., 3600 r.p.m.

One Westinghouse motor-generator. Generator 125 volt, 200 amp., 1120 r.p.m., 25 kw. Motor, induction, 440 volt, 40 hp., direct-connected.

In case of trouble with the transformers, a 440-volt current can be furnished directly by a Westinghouse 500 kw. turbo-generator, 657 amp., 3600 r.p.m. Direct-connected to a Parsons turbine.

Direct current for railway and general D. C. lines is furnished by two Westinghouse motor-generator sets. Each generator is 250 volt, 800 amp., 200 kw., 600 r.p.m., driven by a synchronous motor, 440 volt, 290 horse-power.

The crane has a span of 56 ft. 11½ in., and a capacity of 20 tons with a factor of safety of five.

THE MACHINE-SHOP now handles not only all repair work for the smelter, but all heavy repairs for the mine, the present shops at Jerome being inadequate for more than light work. This is only a temporary arrangement, as with the completion of the new surface plant at Jerome, the shops at the mine will be able to do all the mine work, and the machine-shop at the smelter will be used only for smelter work.

One of the first features noticed on entering the shop is that most of the machines are driven by counter-shaft. This is because almost all the present equipment has been in use several years; at the time it was purchased, individual drives were just beginning to come into vogue, and the management at that time decided in favor of the older system. J. A. Magill, the foreman, who courteously showed me through the shop, believes that individual drives would be better, thus confirming my observation as to the trend of recent practice.

There are two line-shafts, each driven by a 20-hp. Westinghouse motor, type MS, 440 volt, 60 cycle, 845 r.p.m. One line-shaft drives the lathes; the other drives the milling-machines, drill-press, planers, etc. Two machines are recent installations and have individual drives, namely, the boring-mill and the power-press. It has been found that the line-shaft driving the milling-machine and planers is a little short of power when the big planer is run.

The equipment is as follows:

In general big work, an old model 72-in. lathe of unknown make.

One 24-in. by 48-in. Le Blond heavy-duty gap lathe. Bed: closed, 14 ft.; open, 20 ft.

One 24-in. Hendey lathe, 14-ft. bed.

One 18-in. Prentice lathe.

One Detrick & Harvey Machine Co. open-side planer, 48-in. by 48-in. by 16-ft. bed.

One 28-in. Crank shaper.

One 20-in. Gould & Eberhardt shaper

One Le Blond No. 4 Plane milling machine.

One 6-ft. radial drill-press, full universal, made by American Tool Works Co.

One Cincinnati drill-press, 24-in. table.

One 60-in. Gisholt boring-mill. This has an individual drive, a Westinghouse CS 7½-hp. motor, 440 volt, 855 r.p.m.

One 400-ton power-press, used principally for forcing car-wheels on axles. This also has an individual drive, a G. E. type, 1 10-hp. motor, 440 volt, 865 r.p.m.

One Acme single-head bolt-cutter.

In addition to this major apparatus, there are the usual auxiliary grinders, power hack-saws, and similar equipment.

The tool-room is equipped with a No. 3 Cincinnati universal milling-machine; a B. & S. No. 2 Universal grinder; an 18-in. American tool lathe; and an 18-in. Aurora Tool Works drill-press.

Mr. Magill, in commenting on the suitability of the entire shop to the needs of the smelter, stated that in general it performed its work well. He has found that the lathe sizes are not sufficiently different, and believes that a 16-ft. boring-mill, with a 72-in., a 48-in., and a 24-in. lathe, would give a better range. A slotting-machine, especially for key-ways, would be an improvement. All internal key-ways must now be cut on a shaper or planer; external key-ways are cut on the milling-machine. In the tool-room a simple device that has been much used is a 'backing-off' attachment for automatically putting the clearance on reamers and taps. This is attached to the 18-in. lathe, and when once adjusted as desired requires no further attention.

MONAZITE is essentially a phosphate of the cerium earths, but its commercial value is due chiefly to the presence of a variable amount of thoria, the oxide of thorium, according to a publication issued by the British government. This is extracted from it by chemical treatment and marketed in the form of thorium nitrate for use in the manufacture of gas-mantles. The mineral is found in the form of grains, usually of a honey-yellow color, in beach and river sands. Commercial supplies of the sand were first obtained from the beach sands of the Brazilian coast; but deposits of a closely similar character were found some years ago on the coast of Travancore in southern India, and they have since been found in Ceylon. Monazite sand can be easily identified as a rule by its color, the well-rounded form of the grains, its high specific-gravity (about 5.2), and weakly-magnetic character. In consequence of this magnetic character it can usually be isolated from the other heavy minerals by means of an electro-magnet. Monazite shows a characteristic absorption spectrum, but is best identified by the physical characters already enumerated, and by the fact that it yields a phosphate reaction.

Labor the Holder of the Nation's Wealth and Income—I

By W. R. INGALLS

*This study was instituted with the intention of showing the amount of the annual income of the American people, its division between what are commonly classed as capital and labor, and its further division among the classes of labor. It proved impossible to carry out this ambitious plan in its entirety owing to the absence of essential data.

Dr. Arthur L. Bowley recently published a similar analysis of the national income of Great Britain before the War. Although he made a far better study for British conditions than I have been able to do for American, he encountered similar difficulties, and remarked that "material for such a task is of that unco-ordinated, incomplete, and sporadic nature which is familiar to all those who have tried to obtain general results from official statistics". The same remark may be made with respect to American official statistics. It is not satisfactory that out of the great mass of statistics that are collected and published in Washington there is nothing given that ought to be a fundamental figure, namely, the amount of the total national income, nor even sufficient data to permit that figure to be deduced.

In the greatest economic disturbance of the world's affairs that there has been since the Thirty Years' War, and possibly that there has ever been, nothing but imperfect statistical information respecting the wealth and income and earning capacity of the countries of the world exists. John Maynard Keynes in his book on the 'Economic Consequences of the Peace', the most important economic production reviewing the consequences of the War to Europe, and we may say to the world, shows that the conference in Paris did not posses adequate information (and for that matter did not pay proper attention to what it had).

In this paper I show that we do not have in this country any good inventory of its wealth, any satisfactory computations of annual gross and net income, any regular enumerations of either the total number of workers in the country or their classification according to industries and occupations, any comprehensive data as to their earnings. I believe that this paper is the first to draw attention to this, and offer even rough estimates for the situation in recent years. Previous to this paper I do not believe that there was ever any computation of the quantity of all the basic commodities produced in the United States, and even now there are no data of the quantity of products exported, the only summaries of the elaborate statistics of the Department of Commerce and Labor being in terms of dollars, which, in view of the extraordinary rise in prices since 1914, afford but little idea of what has really happened.

*From 'The Annalist', of September 13, 1920.

Although the study, begun in March 1919, whereof the results are summarized in this paper was side-tracked for several months for the reasons stated above, it has seemed to me advisable, in view of the great importance of the subject and the bearing of certain revelations that can be made with assurance, to publish the general outline in spite of its fragmentary nature and unsatisfactoriness as a whole. Let it be understood therefore that I am not offering dogmatically everything that is to be found in this paper, but am presenting it simply as a contribution that will be indicative and suggestive. Nevertheless, I feel a confidence that my conclusion, especially as to the capitalistic share of the produce of industry is substantially correct. It is not far out of line with what Bowley has deduced for Great Britain, and is almost identical with data for Australia.

In an editorial in 'The Age' of Melbourne, September 5, 1919, it was stated that "the figures of the Commonwealth statist show that our total national income is £240,000,000, and of this £159,000,000 is spent in wages and salaries, and £81,000,000 is paid as a 5% income on property. In the aggregate rewards of our Australian production the wage-earners and income receivers under £500 get four-fifths of the total, and the 'fat men' only one-fifth". Compare these data with figures in my summary for the United States, which follows immediately.

The main conclusions of this paper are the following: The fixed wealth of the United States in 1916 was about $260,000,000,000, whereof about $30,000,000,000 was in stocks of goods and all the rest in real estate, railways, etc. The population of the country was about 102,500,000 souls, of whom about 41,000,000, men and women, were workers, about 14,000,000 of them being farmers. The total national produce was about 1,200,000,000 tons of goods, worth from $45,000,000,000 to $50,000,000,000. Out of that produce a group of people aggregating a little more than 400,000, who received incomes in excess of $3000 and paid income taxes, got about $7,900,000,000. Less than one-half of that was derived from investments and more than one-half came from the personal efforts of this class. Persons enjoying income of less than $3000 received about 44% of the dividends paid by corporations and a much larger proportion, perhaps 75%, of the Government, State, municipal, and corporate interest payments. There remained from $23,000,000,000 to $28,000,000,000 to be divided among 27,000,000 non-agricultural workers, who received an average of somewhere between $855 and $1040 each. Among the great classes of workers there is a wide difference in earnings. The farm-hand in 1916 averaged about $400, the factory worker $675, the steam-railway man $886, and the metal miner $1250. Some classes probably averaged higher wages than the metal miner.

The purely capitalistic return, that is, profits, interest, and rent, upon the wealth of the country cannot be determined, but apparently is only a small percentage, certainly less than 5% on the fixed wealth. If the non-agricultural wage-earners in 1916 could have appropriated all the income of the class of people receiving more than $3000 they would have added less than $300 to each of their own incomes, but in fact they could have done no such thing, for the large sum ascribable to the personal efforts of business and professional men would not have been available for division.

Since 1916 the population of the United States has been increasing at the rate of about 1,700,000 per annum, but the aggregate production of goods has increased scarcely any. Out of the substantially stationary production, much has been wasted in warfare and much has had to be supplied to the people of Europe. The quantity available per person in this country has therefore diminished. The talk about labor henceforth participating to a greater extent in the produce of industry is mostly nonsense, for labor already gets all that may be divided, and the only way it can get any more is to produce more. When labor thinks that it is getting more of the produce of industry by extortionate strikes, as a whole it is doing no such thing. The quantity of goods consumed by the 400,000 income-tax payers is relatively insignificant. What really happens is that one class of labor, in order selfishly to satisfy itself, diminishes the ability of other classes of labor to obtain their needful share of goods. Manifestly conditions that enable some wage earners to bid shoes up to $12 per pair do not greatly trouble people in the tax-paying class, but do prevent many other wage-earners from having any shoes at all, or else having them at the expense of something else.

Amid the idealism of the day in the preaching of industrial democracy and the uplifting of the downtrodden these conclusions may appear cold and sterile, but they are not. If people can get into their heads the idea of the division of goods instead of the division of dollars they may become less extravagant in the use of goods and more fruitful in the production of them. The evils of the time and their corrective are condensed in this formula.

There is at present a worldwide unrest among the people of the civilized world, which may be expressed in the most temperate way as the desire of the wage-earner for a larger share of the product of industry. This statement implies that heretofore the wage-earner has not been getting either a fair or a satisfactory share; and that there is a further portion of the product of industry that he ought to get, can get, and proposes to get. Sociologists have sanctioned this view and this program. Politicians have bowed to it. Even industrial leaders, to a considerable extent, have conceded it. There have been few to deny it, except economists of the coolly calculating school, who have pointed out that people cannot divide among themselves more than they have got.

Illuminating object-lessons have passed with scant attention. Among these have been the cases, like that of the railways of Great Britain, where the workers in an industry have demanded and have been granted more than the industry produces, the deficit being paid out of the national purse. Yet it should be obvious even to the humblest intellect that if every industry should be put upon such a basis there would be nothing in the public purse out of which to pay deficits, which is simply to say that all of the people cannot get any more than they earn, although one class may do so temporarily at the expense of other classes. There is, without doubt, a theory that something more can be taken out of what are called the capitalistic and employing classes, which indeed is the only possible meaning in the demand "for a larger share of the produce of industry". No sensible person will dissent from the idea that it will be useful to examine how much there is in it for the wage-earner before undertaking to disturb existing conditions.

I dwelt upon this subject in an address to the Mining and Metallurgical Society of American in January 1919, in which I asserted that in 1916 American wage-earners received about 80% of the $50,000,000,000 produce of American industry in that year, their earnings being divided among 40,000,000 workers at the rate of about $1000 each and that the sum of $10,000,000,000, which was the share of capital, was only about 4% on the wealth of the nation, estimated at about $250,000,000,000. I stated that those estimates were very rough, but maintained that they were probably near enough to give a reasonable idea respecting the division of the produce of industry. Since then I have continued study of this subject and am now able to give some more accurate and illuminating indications. I take the year 1916, that being the latest for which sufficient figures are available.

Before entering upon any consideration of the gross revenue and net earnings of the country it will manifestly be desirable to get some idea of what is the wealth of the country, its capital, so to speak.

The wealth of the United States, chiefly in farms, factories, forests, railways, and other public improvements, developed mines, houses, etc., has been commonly estimated at $230,000,000,000 to $250,000,000,000 as of 1916. It is obviously imposible to make anything like a complete inventory and valuation of such property, but there is more or less reason to believe that even the higher of these figures is too low.

The basis for most calculations on this subject is the bulletin of the Bureau of the Census on 'Estimated Valuation of National Wealth', published in 1915 and giving data for 1912. Estimates for later years are commonly computed on the principle of proportionate increase. Such results may be highly erroneous, especially when it be considered that not only the multiplier may be wrong but also the base that is multiplied. Figures once given in a Government report are too often assumed to be specific and accurate. Critical examination of the figures givin the details of the national wealth in 1912 reveals that they were in many cases mere estimates multiplied from some previous base and should not be accepted upon any other understanding. I have tried to make an estimate of the national wealth in 1916 upon the principle of an inventory. The census figures for 1912 are given for comparison.

My estimates for 1916 are very rough, are offered but tentatively, and are freely open to criticism, suggestion, and revision. They serve merely a purpose in showing the forms in which national wealth exists, and about how much there is in each form. This appears in the accompanying table.

Wealth of the United States

	1912	1916
Real estate	$110,676,333,071	$150,000,000,000
Mines	.....	8,000,000,000
Live-stock	6,238,338,985	7,235,000,000
Farm implements	1,368,224,548	1,675,000,000
Manufacturing machinery and tools	6,091,451,274	8,000,000,000
Gold	2,616,642,734	3,000,000,000
Silver		1,000,000,000
Railways	16,148,532,502	20,500,000,000
Trolley-lines	4,596,563,292	5,000,000,000
Telegraph and telephone	1,304,685,743	1,500,000,000
Pullman cars	123,362,701	130,000,000
Ships	1,491,117,193	1,000,000,000
Canals		1,000,000,000
Irrigation enterprises	360,865,270	400,000,000
Water works, privately owned	290,000,000	300,000,000
Light and power, privately owned	2,098,613,122	4,500,000,000
Gas plants	.....	3,500,000,000
Furniture, carriages, etc	8,463,216,222	9,220,000,000
Clothing, jewelry, etc	4,295,008,593	5,120,000,000
Stocks of goods	21,576,065,840	29,520,000,000
Totals	$187,739,021,090	$260,600,000,000

I am inclined to think that my estimate for 1916 is still too low. For example, ships are reckoned at only $100 per ton, while the United States Emergency Fleet Corporation is now holding them at $200 per ton. The conservative character of other estimates will appear from the explanatory notes that follow.

No allowance is made for the foreign investments of the United States, which even in 1916 were considerable. However, the huge loans to foreign governments did not begin until 1917, although the Anglo-French and other issues had been taken previously.

American investments in mines, railways, and other fixed property in Mexico and South America were, of course, considerable.

The foregoing estimate of the wealth of the United States pertains only to the fixed wealth of the country. There is also a large intangible wealth, which represents work done and stored up just as much as railways do. Thus the publishing business of the country is worth vastly more than the real estate, machines, etc., that are used in connection with it. The mere organization for the purpose of conducting all kinds of business is a form of intangible wealth that has been acquired only by vast expenditure of work and is immensely valuable. In some respects such intangible wealth ranks among the strongest forms of property. A house may be destroyed by fire, suddenly and within a few hours, but the fame of a newspaper which maintains its circulation is apt to be a lasting thing. The value of intangible property is well recognized among persons experienced in business, but is not understood by the inexperienced.

Boron and its compounds find a use in the copper industry. They act as scouring agents in molten copper, and copper castings of high electrical conductivity and dense quality are obtained by their use. Boron is also used in the manufacture of aluminum bronzes of great strength, in hardening and strengthening aluminum castings, and in the manufacture of nickel castings.

Cobalt

*Cobalt minerals are uncommon except in the Cobalt district, Ontario, Canada, where they occur in ores that are worked for their silver content, the cobalt produced being a by-product. The smelting and refining of this ore has recently been described by Sydney B. Wright ('Mining and Scientific Press', January 25, 1919, p. 125). As these ores are brought to various smelters, according to changes in smelting contracts, the material comes on the market from different places at different times. In the main it is marketed as cobalt oxide; the metal is produced from the oxide by reduction. The principal use of the metal is in the patented alloy known as stellite (about 80% cobalt), which is used as a high-speed cutting-tool in place of steel (Transactions A. I. M. E., Vol. 44, p. 573). Cobalt is also used in a high-speed tool steel which contains 4% cobalt and 16% tungsten. It is also claimed that it can be used as a substitute for nickel in plating, the rate of deposition being faster than with nickel and a thinner coating giving equal protection. Cobalt compounds are used for coloring pottery and glass, to which they impart the shade known as delft blue, and also certain purple shades.

The cobalt output of Canada in 1916, according to official statistics, was 841,859 lb.; of which 215,215 lb. was in the form of metal. The oxide produced amounted to 670,760 lb., and there were smaller quantities of sulphate, carbonate, and hydroxide of cobalt. Up to the present time the supply of cobalt available from the Canadian ores has been abundant to meet all demands. There are only two sources of cobalt in the United States that are of any importance. A deposit at Blackbird, Idaho, is owned by the Haynes Stellite Co., which has erected a plant for the production of cobalt concentrate. Cobalt, nickel, and copper sulphides occur in association with lead ores at Fredericktown, Missouri, and some cobalt oxide is now being produced by the Missouri Cobalt Co. The price of cobalt metal has averaged about $2 per pound in the United States.

The U. S. Bureau of Mines has issued a bulletin in which it is said that numerous accidents are still being reported that have resulted from the delayed explosions in drill-holes. Some of these accidents have been due to retarded burning of the fuse, causing the charge to explode after the miners had returned to the face, but the majority have been caused by the miners drilling or picking into unexploded explosives, either in unexploded holes or in broken rock. Although the industry has been cautioned by the Bureau of Mines, manufacturers of explosives, and other agencies regarding the care that is necessary in the handling of explosives, yet reports of these accidents are still being received and many of the accidents are fatal. They occur in spite of the best efforts of the mine officials and men, but many of those that have been reported could have been avoided.

U. S. Bureau of Mines.

Platinum

*The following statement regarding platinum is issued in response to numerous inquiries. In preparing it a number of authorities have been consulted, the publications of James M. Hill of the U. S. Geological Survey having been especially drawn upon.

Physical Properties. Platinum is a white metal with a grayish tinge, and takes a high polish but one less brilliant than silver. It is malleable and ductile, and can be rolled into thin sheets and drawn into fine wire. These properties are impaired by the presence of impurities. It has a specific gravity of 21.3 and a hardness of 4 to 5, being harder than copper, silver, or gold. It melts at about 1710°C. The atomic weight is 195.2.

Chemical Properties. Platinum is not acted on by dry or moist air even when heated to high temperature. It is not attacked by hydrochloric, nitric, or sulphuric acid, but when alloyed with silver, copper, lead, zinc, and some other metals, it is partly dissolved by nitric acid. At high temperature it is attacked by fused alkalies in the presence of air and by potassium and other nitrates when air is excluded. It is also attacked at high temperature by carbon and by silica in the presense of carbon. Platinum vessels should, therefore, never be heated in contact with solid fuel. Cyanides likewise attack it.

Uses of Platinum. Owing to its resistance to the action of acids and most chemical agents even at high temperatures, and to its high melting point, it is in extensive use for the manufacture of crucibles, basins, foils, wire, etc., and for chemical laboratory work. A large quantity is also used in the construction of apparatus for the catalytic manufacture of concentrated sulphuric acid. A considerable amount is consumed in the electrical and dental industries and in the preparation of salts, notably the chloride for photographic work. There has been also a large demand for it by jewellers.

Alloys and Substitutes. The making of alloys of platinum and substitutes to take the place of platinum has been seriously studied and to some extent platinum has been replaced. There is no question that other combinations or substitutes will be developed in the future, but no substitutes to take the place of the platinum contact points in high-grade magnetos and for numerous other purposes has so far been found. Alloys of gold and palladium which cannot be told from platinum by ordinary physical properties, are now used in dentistry, jewelry, and to a limited extent in chemical apparatus.

Ores of Platinum. Platinum occurs native in alluvial deposits derived from the disintegration of primitive rocks in the form of grains approximately spherical but less often flattened. Nuggets of large size are rare, but a number of small nuggets are found in the Ural region and one weighing 270 oz. is recorded by Hautpick as having been found in the placers of Mt. Katchkonara, in the northern portion of the platiniferous district of the Ural, Russia. A still larger one, weighing 21.64 lb., is in the Demidoff museum, at Petrograd. The most extensive deposits of platinum are the alluvial sands of the Ural. They are contained within a length of about 80 miles along the central part of the chain in the province of Perm, the principal centres of the placers being at Blogodat on the eastern and Niji Tagilsk on the western slopes. This field furnishes the main part of the world's production of the metal. In Colombia, on the Condoto and upper Atrato rivers, are important platinum deposits, which are attracting considerable attention at this time. The production of platinum from Colombia is steadily increasing. Platinum is associated in the placers chiefly with gold, iridosmine, chromite, magnetite, zircon, ilmenite, corundum, and quartz. The admixture of gold is variable, ranging from 2 to 3% in some districts to as much as 75% or more in others. Among the metals of the platinum group are iridium, palladium, and rhodium, which are intimateely combined with platinum and can be separated or determined by careful chemical analysis.

Occurrence. The mother-rocks of platinum are of the basic igneous type, such as peridotite, pyroxenite, and dunite. The peridotites and pyroxenites are dark-gray to black heavy rocks composed principally of black or dark-green iron-magnesium silicates, pyroxene, augite, and hornblende, olivine, plagioclase feldspar, chromite, ilmenite, and magnetite. Dunites are composed principally of olivine with some chromite. There is every gradation between these types of rocks and the less basic rocks. A characteristic of the basic rocks is their tendency to alter to serpentine, a soft greasy fibrous mineral of olive-green to black color that once seen is readily remembered. Attempts to trace platinum to its source have proved successful in Russia, Spain, and Canada, but no deposit of platinum in the mother-rock has been found of commercial grade under normal conditions. It is possible, but does not seem probable, that bodies of platiniferous rock may be found in the United States rich enough in platinum to be worked under present conditions. It should be recalled, however, by all persons searching for platinum ores that the assay for platinum is difficult and apparently cannot be successfully made by all commercial assayers. It is therefore strongly recommended that samples of supposed platiniferous ores be sent only to the most reliable analysts.

Black Sand. Most of the platinum produced in the United States is recovered as a secondary mineral from placer operations and from the electrolytic refining of gold bullion and blister copper. From time to time the beach-sand of Oregon and northern California has been exploited by promoters on the basis of the gold and platinum content. A successful method of mining this sand must be based upon a thorough prospecting of the

*Issued by U. S. Bureau of Mines.

deposits. Investigation has shown that in general the black-sand deposits are disappointing in both quantity and quality, and while in a few places there has been sufficient surface concentration to permit of small mining operations, these deposits rarely contain enough gold and platinum or occur in adequate extent to be operated at a profit.

METALLURGY. In general, the crude platinum of the Western placers is found in relatively small scales or flakes, some larger than one-eighth inch in diameter, but the majority less than one-sixteenth inch in size, many being under one thirty-sixth inch. These flakes have a tendency to elude capture in the ordinary miner's sluice and probably a large part of the flake gold and platinum has hitherto been carried in suspension to the tailing-piles. Undercurrents in the sluice-lines have added to the saving of the fine gold, but they are not entirely satisfactory as savers of gold and platinum. Burlap and canvas tables have also been used with some success. Many types of specially designed machines have been tried and discarded, though undoubtedly some have merit and a few are making a fairly satisfactory saving. In the treatment of beach-sands concentrating tables are also used.

The loss of fine gold and platinum in ordinary hydraulic operations is due to several causes, among which may be mentioned running pulp too fast and agitating it too much to permit settling, failure to clean up often enough to prevent packing of riffles with consequent formation of smooth slopes over which metals readily flow under pressure, and failure to provide settling-boxes for fine material carried in suspension. On some of the gold-dredges various devices to effect a closer saving of the fine gold and platinnum lost in the tailing have been tried. The most successful has been the Neill jig and the Hardinge mill, which are in operation on two of the Natoma dredges in California. It was found on some of the other dredges of this company and of other companies in the State that the recovery effected by this tailing-plant was not sufficient to justify the expense of its installation. In other words, there was very little platinum or fine gold in the tailing. In addition to the platinum recovered from placer operations, some platinum and palladium is recovered from the platiniferous ores of the Boss mine in Nevada and the Rambler mine in Wyoming. These ores are concentrated locally and sent to refiners for final treatment. The United States Smelting & Refining Co., and the Irvington Smelting Works buy ores. The crude platinum is separated from the sand and gravel, as already stated, by a series of washing processes. If any gold is present it is obtained in the concentrate together with the platinum. In Russia the gold is removed by repeated amalgamation with mercury in wood, iron, or porcelain bowls, about 10 to 30 lb. being treated at a time. The crude platinum is then almost all exported to be refined abroad, not more than about 2% being refined in the country.

REFINING. The crude platinum can be refined either by dry or by wet methods. When dry methods are employed, any iridium and rhodium present will remain with the platinum; on the other hand, when wet methods are used, the resulting platinum will be pure. A combination of the two methods is also employed. The wet method consists essentially in dissolving the crude platinum in aqua regia, precipitating the platinum as ammonium platinichloride, heating the precipitate to redness, forming spongy platinum, and fusing the latter by the oxyhydrogen blow-pipes in a furnace constructed of blocks of lime. The refining of platinum ore is a complicated matter.

The principal buyers of crude platinum in the United States are the following firms:

American Platinum Works, Newark, New Jersey.
Baker & Company, Newark, New Jersey.
Belais & Cohn, 13 Dutch street, New York City.
Bishop & Company, Malvern, Pennsylvania.
Pacific Platinum Works, Los Angeles, California.
Shreve & Company, San Francisco, California.
H. A. Wilson Company, Newark, New Jersey.
S. S. White Dental Company, Philadelphia, Pennsylvania.

HINTS FOR PROSPECTORS. The placer deposits containing platinum are all, so far as known, in the vicinity of areas of basic igneous rocks, and in any search for new deposits of platiniferous gravels the first step is to find outcrops of peridotite, pyroxenite, dunite, or serpentine. When these have been found, the gravel in streams flowing out should be washed to ascertain if platinum is present. The natural concentrate found in alluvium containing platinum is usually rich in chromite and olivine. The character of the rock particles often gives a clue to the source from which the gravel was derived. Platinum, as it occurs in a placer concentrate, is ordinarily a silvery white metal that could be confused only with silver, and possibly pieces of iron or steel. It can be distinguished from both of these metals, as they are soluble in dilute nitric acid; crude platinum can be dissolved only in concentrated aqua regia, a mixture of three parts of hydrochloric (muriatic) acid and one part of nitric acid. In some placer deposits the grains of platinum are coated with a dark film and somewhat resemble the grains of the dark minerals chromite, magnetite, or ilmenite, from which they are separated by careful panning, as the specific gravity of platinum is greater than that of any of those minerals.

Platinum will not amalgamate with quicksilver alone, but will amalgamate if sodium is added. In ordinary quicksilver the flakes of platinum float on the surface and can be removed. If sodium amalgam is used, the platinum may be separated from gold by agitating the amalgam with water until all the sodium is used up to form sodium hydroxide; then the platinum will come out on the surface of the amalgam, provided, of course, the amalgam is sufficiently liquid. Platinum can be scratched with a knife. It is so malleable that it can be pounded, without heating, into very thin sheets. It is practically infusible; the grains cannot be melted together as particles of gold can.

A relatively simple chemical test can be made to determine platinum: The metallic particles are dissolved by boiling in concentrated aqua regia, allowing the resulting solution to remain on the stove until dry. The residue is dissolved in hydrochloric acid and evaporated by boiling until the solution is thick but not quite dry. This mass is dissolved in distilled water and a few drops of sulphuric acid and of potassium iodide solution are added, which, in the presence of platinum, causes the solution to turn a characteristic wine-red, if much of the metal is present, or to a reddish pink in the presence of small quantities of platinum. The test outlined above is fairly delicate, but it cannot be used to detect traces of platinum in the presence of large quantities of iron or other elements.

A second test may be applied to the aqua regia solution after the re-solution in hydrochloric acid outlined above. In this test potassium chloride is added to the solution, which precipitates yellow crystals of potassium platinic chloride, if platinum is present.

A third test may be applied: Add ammonium chloride to the aqua regia solution; this will precipitate yellow crystals of ammonium platinic chloride, if platinum is present.

The precipitates from the second and third tests are insoluble in alcohol, but are soluble in water, and may be reduced to platinum sponge by heating.

All these tests are comparatively simple and positive when made on single grains, but they cannot be relied upon when various other elements are present in the material tested. It is, therefore, recommended that their use be restricted to grains of a single mineral picked from the concentrate obtained by panning a sample of either rock or gravel.

Radium

*The United States is the foremost radium-producing country in the world. This ascendency has been gained notwithstanding that 500 tons of American ore is required to produce the one gramme of radium that has been obtained from five or six tons of European ore. A gramme is about a thimbleful.

The first radium produced in the United States was obtained in 1913 in the laboratory of the Standard Chemical Co. Since then the production of this company has been as follows:

	Radium element grammes
1913	3.1
1914	9.6
1915	1.7
1916	5.0
1917	7.0
1918	13.6
1919	11.8
Total	50.8

Up to the present time it has produced almost one-half of the estimated supply in existence.

Radium preparations in the United States are spoken of and measured in terms of radium element. Until recently European scientific men have adhered to the term radium bromide. Crystalline radium bromide when pure contains only 53.6% of radium element. There was no common standard. The original method of measuring radium, consisted in comparing its activity with that of uranium. During the 14 years this system of measurement prevailed scientific men spoke of radium as "two million times more active than uranium". Trained minds, of course, understood that what was meant was that the quantity of electrical energy emitted in the rays of the radium, small though it was, was two million times greater than that contained in the rays from uranium. Such a ratio of comparison was entirely unsuitable for use especially with small quantities, and about 1912, by common consent, Madame Curie was asked to prepare what would be an international radium standard. This is deposited at Paris. Duplicates are in the leading capitals of the world, and radium preparations are now measured by comparing the electrical energy carried by the gamma rays from the preparation to be measured with the energy carried by the gamma rays of the international standard, or one of the certified duplicates of it. In 1914, the U. S. Bureau of Standards obtained a certified duplicate of the international radium-standard and practically all quantities of radium in this country have been measured by comparison with it.

In the industrial world interest in radium has always been limited by the small amount available. This was especially true of the ten years following its discovery. During that period some attempt was made to use the action of radium in causing a spontaneous and continuing luminescence in substances such as zinc sulphide, to make what is called luminous paint, but prior to 1913 this effort was practically negligible. Radium and radium minerals are not generally luminescent. Tubes containing radium glow from impurities present which the radiations from the radium cause to give light. The War created a most unexpected demand for radium. The necessity of illumination that would not betray presence to the enemy in the various branches of the fighting-service made radium-luminous material the most satisfactory and dependable light. The demand for the luminous watch-dial alone raised one use for this material to a fair-sized industry.

Therapeutically, there has been a gradual and steady increase in the use of radium since 1912. The earlier over-enthusiastic statements of the value of radium in the treatment of cancer have not been wholly confirmed and radium is far from being the panacea in the treatment of diseases. Nevertheless surgeons throughout the world are gradually admitting that radium is a necessary adjunct to the treatment of cancer.

*Abstract from an article by Hamilton Foley in the 'Chemical Age'.

THOSE who are called upon to do blasting should be familiar with the publications of the U. S. Bureau of Mines dealing with explosives. One of the best papers is Bulletin 80. 'A Primer on Explosives for Metal Miners and Quarrymen'.—U. S. Bureau of Mines. Reports and Investigations.

The McFadden Bill

*In an interview given out on October 7 by Representative Louis T. McFadden, Chairman of the Committee on Banking and Currency of the House of Representatives, he asked the following pertinent question with reference to the gold situation: "Is the United States to continue to ignore the problem of gold production, thus permitting the British Empire to gain an unquestioned supremacy?"

An estimate of the gold production of the United States based on the output for the first six months of this year indicates that the production for 1920 will be less than half the amount produced in 1915. In 1915 the United States produced 21.5% of the total world's gold output, and the British Empire 63.7%. In 1919 the United States produced but 16.6% of the world's gold output, while the British Empire produced in excess of two-thirds. Since July 24, 1919, the British Empire has been paying an exchange premium as high as 50% to the gold producers of South Africa, where the bulk of the British gold is produced, while in the United States no assistance has been rendered the gold-mining industry. This year the contribution of the United States to the gold production of the world will probably be not more than 12%, about half of that which it contributed in 1915, while the stimulating effect of the exchange premium will probably increase the quota which the British Empire will contribute to 75%.

As compared to 1914, the purchasing power of the dollar in terms of all commodities in 1919 was 47 cents. The gold producers' ounce in 1914 had a purchasing power of $20.67, whereas during 1919 the same ounce could purchase in terms of all commodities but $9.70. Since the price of gold is fixed by statute at $20.67 an ounce, the gold producer is in the same position as a person who received the same income in 1919 as in 1914 and finds that a $2000 income has shrunken in purchasing power to $970. "This is the principal reason for the decline of the gold production of the United States from $101,000,000 in 1915 to less than $50,000,000 this year," said Mr. McFadden.

The U. S. Mint sold for industrial consumption during 1919 nearly $22,000,000 more gold than was produced from the mines of the United States, while this year the drain on the monetary gold stock will probably be $40,000,000. The American Bankers Association passed a resolution on October 2, 1919, urging upon the Government the necessity for maintaining a domestic production of new gold in sufficient volume to satisfy the industrial requirements of the arts and trades. To comply with the specifications of this resolution, the soundness of which cannot be questioned, I introduced H. R. 13201 on March 22, 1920.

Since the industrial consumers of gold are the only ones in the country receiving raw material at the pre-war price, while the general increase in all commodities was 112% in 1919 as compared with 1914, it is evident that they are being heavily subsidized. Mr. McFadden emphasizes that the imposition of this excise tax merely adjusts the cost and price equation between the producer of new gold and the consumer of gold in the industrial arts, and is free from all monetary entanglements. A free gold market is maintained under the provisions of this bill for the reason that the excise tax is collected on the finished product as sold, and not upon the bullion which is sold to the manufacturers. There is nothing in the bill which in any way alters the number of grains in the standard dollar, the unit of our monetary system. The bill creates the governmental machinery by which the consumer of gold in the industrial arts may pay more nearly the cost of production for his raw material. The stimulus to the gold producer specified in this bill is equal to the excise tax imposed, and is no greater than the exchange premium paid by Great Britain in the latter part of 1919 to the South African producer, whose operating conditions are more favorable than those in the United States.

In addition to paying the exchange discount, which in the case of the French industrial consumer of gold would amount to 100% more in francs than the price paid before the War, the French government has imposed a sumptuary tax for the use of gold in the fabrication of articles (other than money) of 60 francs per hectogram ($3.73 per fine ounce) by law of June 25, 1920. Previous to that date the guarantee tax was 37½ francs per hectogram. The French government justifies this tax in a formal document transmitted by the U. S. Bureau of Foreign and Domestic Commerce, as follows: "Moreover this tax, striking as it does luxury goods, or unessential articles, enters into the category of a sumptuary tax, the levying of which is admitted by all economists as a legitimate procedure."

It is important that the gold-mining industry be kept alive for fear that with greatly reduced production there will be difficulty in retaining the gold standard during a popular campaign for credit restriction accompanied by declining prices. The continued depletion of the gold stock by excess exportation and industrial use will seriously impair the public confidence in the Nation's finance and currency unless a normal gold output is insured.

The gold-mining industry will be completely shut-down unless constructive aid is provided without delay, in which event it will take years to develop a normal output of gold at a very much greater expense. To allow the gold mines of the United States to cave in and fill with water entails a waste of developed gold resources, which in a most critical hour of financial need will cause want. No argument can be made in favor of waste. The time to act is now before the industry is shut-down.

Misfires should not be approached even for the purpose of inspection until three hours have elapsed, if fuse was used, and ten minutes, if electric detonators or electric igniters were used. These are minimum recommendations. It would be preferable to allow a longer time, for fuses have been known to hang fire as long as twelve hours.

*Issued by Mr. McFadden himself.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

HIGH-GRADE ORE FOUND IN THE LOST DUTCHMAN.

Patagonia District.—The Three-R mine is reported to be diamond-drilling with excellent results. R. R. Richardson has a large force of men also at work in Josephine canyon 18 miles north-west of Patagonia. It is said that the McDonald mine in the Santa Ritas is working a full force on the 300-ft. level, cross-cutting north to intersect a vein under the old workings.

Globe-Miami District.—It is reported that the Inspiration-Needles property has been sold to the British Inspiration Copper Co. News has just been received in Globe that ore assaying in the neighborhood of $408 per ton has been found in the old and famous Lost Dutchman mine, situated near Fish Creek hill, on the road between Phoenix and Roosevelt. The assay is said to have been taken from the face of a drift on the 100-ft. level, and was not picked ore in any sense. The Lost Dutchman mine, approximately forty years ago was the property of Jacob Wolz. Prospecting for its re-discovery has been carried on since 1913, and the present property located.

Hillside.—The Lawrence group of mines in the Eureka district is reported to have been taken over by W. J. Mayer and C. E. Barton, from C. C. Stukey of Prescott. Development, it is said, will be undertaken by a new corporation, known as the Bagdad-Hillside Mining & Development Co.

Mayer.—The Arizona-Binghampton is reported to be milling 200 tons per day, with a monthly production of 300,000 lb. of copper. The Shannon Copper Co. will shortly resume operations on its Yeager Canyon property. Reports are current that production has commenced at the Gillespie property of the Arizona Copper & Mining Corporation and a twenty-ton mill will be erected to handle a developed ore-reserve of approximately 20,000 tons.

Jerome.—Mining conditions around Prescott and Jerome are reported as steadily improving. The present stable condition of the silver market is creating a feeling of confidence, and many of the old silver mines have been re-opened and new ones located. The Verde Central Copper Co. reports excellent showing in the face of the tunnel. Jack Hooper, formerly in charge of the Gadsden property of the Calumet & Arizona Mining Co., is now in charge of operations at the Zonia mine, near Kirkland. Two shafts are being sunk on this property and indications are promising.

Kingman.—The Gold Ore is reported to have struck a four-foot vein sampling about $40 per ton in its east drift. Ore also is said to have been struck in the west drift.

Parker.—Announcement is made that development will be resumed at the property of the Arizona Standard Copper Co., 14 miles east of Parker. It is reported that a leaching-plant and a four-unit ball-mill will be installed at once. Each unit will be capable of milling 125 tons of ore per day and the company expects to be operating within four months.

Globe.—The Iron Cap Copper Co. has recently filed suit in the Superior Court against the Arizona Commercial Mining Co. to prove apex rights. The first action in this matter was filed in the courts of Massachusetts, those courts having denied jurisdiction, the company took it into the equity court of the State of Maine. The suit filed here on October 5 is expected to finally settle the litigation and will probably be tried in the near future.

Pearce.—George Brown, general manager for the Middlemarch properties has reported that 20 men are employed developing more water for the mill. The shaft has been sunk 130 ft. deeper and drifting is in progress. Recent differential-flotation tests on the copper-zinc ore are reported as successful and operations will commence as soon as sufficient water is developed.

Oatman.—Judge Bollinger has not yet recovered from injuries received in the wreck of Governor Cox's special, and the case of the Tom Reed Mines Co. against the United Eastern Mining Co. has therefore been postponed from October 4 to November 8.

MICHIGAN

THE COPPER MARKET VERY DULL BUT OPTIMISTIC FOR THE FUTURE.

Calumet.—Metal shipments from the Lake have been negligible for the past several weeks and the copper is piling up on the docks, awaiting a turn in the price. Even domestic business seems to be at a standstill and industries that formerly consumed large quantities of copper are entirely out of the market. Notwithstanding this stagnation, production holds well to the normal of the past six months. In fact, most of the companies report an increase in their organizations. This will make for greater production, even though there is no more demand for metal than at present. The belief here is that the worst has been experienced in spite of the fact that the

past week has brought about a slight drop in the price of the metal.

Arcadian Consolidated has resumed sinking in its New Baltic shaft and has gone about 15 ft. below the 600-ft. level. The south-east corner of the shaft is now in the lode. The cross-cut to the vein from the 600-ft. level on the south did not give quite as good a showing as was obtained on the opposite side where the copper content of the lode was exceptionally high. In the New Arcadian shaft, the richest openings are near the northern boundary or the Baltic line, while the lower levels revealed the best mineralization. It will be three or four months before Ahmeek's cross-cut through the Ahmeek fissure penetrates the Kearsarge conglomerate for the work is proceeding slowly. The tunnel is only 6 ft. square, permitting only limited mining operations. Cross-cuts on the fissure are boring toward the conglomerate from the 15th to the 22nd level and also on the 5th and 11th, so it is obvious that each opening will permit a thorough exploration of the Kearsarge. In fact, when Ahmeek completes its openings on the conglomerate it will be pretty definitely established whether the vein contains copper or is barren. Ahmeek's tonnage for September was the best since last winter. The rumor that Hancock Consolidated is to sell its holdings to Quincy has been officially denied. The fact that Hancock and Quincy are jointly installing a concrete reservoir or retaining wall on the 53rd level of Hancock gave rise to the rumor. Victoria is producing between 60 and 75 tons of copper per month. The company has a considerable stock of copper on hand and is selling only enough to meet current expenses. About 100 men are employed in sinking and drifting and the showing at the 28th level is reported by the management as very encouraging. The lode is yielding considerable mass copper as well as good stamp 'rock'. Victoria's cost is lower than the average for Lake Superior producers because both its mine and mill are operated by water-power.

NEVADA

RENO CHAMBER OF COMMERCE ESTABLISHES BUREAU OF MINING INFORMATION.

COPPER CANYON. There has been developed in the mines of the Copper Canyon Mining Co., operating seven miles from Battle Mountain, 1,000,000 tons of ore with an average copper content of 2.40%, according to F. Sommer Schmidt, general manager. The company owns, or holds under option, a total of 3000 acres and a patented mill-site and water-rights. The greatest depth attained in the mines is 310 ft. and most of the ore is exposed, or partly so, through six shafts, the Copper Queen, Contention, Chase, Sweet Marie, Widow, and Empire, extending in a general direction, as named, southeast along the mineralized area. The orebody as now developed in the Sweet Marie is 600 ft. long and 87 ft. wide on the 120-ft. level, with an indicated thickness of 70 ft. This block is estimated to contain 117,600 tons of partly developed 2.58% ore. The orebody, as opened in the Chase on the 130 and 185-ft. levels and by raises from these levels, contains 256,400 tons of partly developed 1.82% ore. The orebody has been developed in the Contention to a depth of 130 ft., above which it has been opened for a length of 300, a width of 100, and a thickness of 40 ft., giving an estimated 100,000 tons of 3% ore. The Copper Queen orebody at a depth of 120 ft. has been opened for a length of 120 ft., a width of $2\frac{3}{4}$ ft., and a thickness of 50 ft., giving an estimated 1500 tons of $12\frac{3}{4}$% ore. The orebody has been opened on the 150-ft. level of the Widow by a 200-ft. drift, with raises driven, at 50-ft. intervals, 40 ft. to the gossan. The average content of the ore in the raises is 7% and in the drift 3%. The width has been narrow, but the ore is widening gradually, and at present the north face consists of a 20-ft. width of 4% material. Mr. Schmidt describes the formation in the district as consisting of limestone, claystone, and quartzite, intruded by monzonite dikes. The ore-bearing sedimentaries dip east at 20 to 30° and they are cut by dikes of varying thickness.

GOLDFIELD.—From June 16, when the Development mill started, to about six weeks ago there was 41 carloads of ore of a gross value of $22,000 shipped to the mill by Florence lessees. This gives a value per ton of about $13, according to unofficial figures. The shippers were the Development, Hinds, Cracker Jack, and Boesch leases. The largest tonnage came from the Reilly block. Few shipments have been made in the last six weeks. The south-east cross-cut being driven by the company on the 358-ft. level has been advanced 1200 ft., according to E. A. Byler, engineer for the company, and the objective is nearly reached. No work has been done west of the shaft recently. The Development has bought the Gold Hill group of nine claims, 26 miles south of Goldfield, on which A. I. D'Arcy, manager for the Development, has furnished the following information: The vein, 14 to 60 ft. wide, is exposed on the surface for 2200 ft. There is 16,000 tons of $8.50 ore partly blocked out, according to assays of 107 samples. The gold is found with limonite, and at one place in the lower tunnel sulphide ore is exposed. The vein is in an almost vertical fault-fissure, of which one side has been faulted down 200 ft. The walls consist of alternate layers of limestone and shale. The vein-filling is porous quartz and limonite, the gold being found in the latter. Cyanide-leaching tests of the ore, crushed to 10-mesh, gave an extraction of 94% of the gold in 72 hours.

RENO. Development of the little-known minerals and metals is contemplated by the Reno chamber of commerce through a recently established bureau of mining information. The bureau purposes to bring together buyers of these minerals and owners of deposits. Owners have been invited to send in descriptions of their properties to the bureau and a file on inquiries and buyers is kept so valuable services can be rendered both parties.

CACTUS.—The Cactus Nevada Silver Mines Co. informs us that the statement in our issue of October 9 was incorrect, the fact being that the company has not laid off any miners and is amply financed through the firm of Fynney & Cutter. We are glad to make this correction.

UTAH

THE INTERSTATE COMMERCE COMMISSION TO INVESTIGATE FREIGHT-RATES IN UTAH.

SALT LAKE CITY.—The shortage of railway cars is affecting the output of coal in Utah. During one week recently, the production was but 71% of normal. Of the other 29%, 23 was due to lack of cars, 5 to mine disability, and less than 1 to labor shortage. At this time of the year, production should average 120,000 tons per week, whereas recently it has been but 85,000 tons per week. One railway serving the coal mines supplied but 50% of the cars needed. The Interstate Commerce Commission has ordered an investigation of the action of the Utah Public Utilities Commission in refusing to permit increase in intrastate rates on coal and ore, similar to the advance in interstate rates. The hearing will begin in this city on November 1.

AMERICAN FORK CANYON.—John H. Wootton of the South Park Mining Co. has a force of men engaged in driving a tunnel opposite the Pacific mine. Mr. Wootton feels confident of finding the Pacific fissure. At the Belorophon property, the mill has been running steadily for several weeks. Fred Leonard, of Salt Lake City, has a surveying party at work at the Silver Bell property, preparatory to active operations. At the Pacific mine the company is accumulating a stock-pile of silver-lead ore of milling-grade, which will be treated when a sufficient quantity has accumulated.

GOLD HILL.—At the present time the Western Utah Copper Co. is shipping about 250 tons of low-grade fluxing ore daily. The company employs the 'finger raise' system of caving, the same as used in the Ruth mine of the Nevada Consolidated Copper Co. The orebody of this company is a replacement in marbelized limestone along a limestone-granodiorite contact. On the surface the ore-shoot is 300 ft. long and from 10 to 80 ft. wide. On the 300-ft. level, the ore-shoot is 150 ft. long and from 60 to 80 ft. wide.

EUREKA.—As a result of development in the Chief Consolidated mine, commercial ore has been found in the new zone at the easterly end of the company's holdings. Some months ago, small bunches of ore were encountered which were not of shipping-grade; these small stringers were followed with the result that the new orebody was discovered. Recently shaft No. 2 at this property reached the contact between the porphyry and limestone. Cecil Fitch, manager, says the shaft now has a depth of 1600 ft., and that it is expected the water-level will be reached by the end of the year. Mr. Fitch states the company is preparing for the annual assessment work on the unpatented claims. This work will include sinking two shafts, one being 4000 ft. north-east of the Central Standard workings, and the other at the extreme north end of the Chief's territory. Shipments from this district for the week ending October 2 totaled 131 cars, of which the Chief Consolidated shipped 30; Tintic Standard, 29; Mammoth, 23; Dragon, 10; Iron Blossom, 8; Eagle & Blue Bell, 8; Grand Central, 6; Iron King, 3; Gemini, 2; Bullion Beck, 2; Swansea, 2; Centennial-Eureka, 2; Gold Chain, 1; Alaska, 1.

Figures recently published by V. C. Heikes of the U. S. Geological Survey show that the silver output of this district during 1919 was considerably over one-half of the output from the entire State; the production being 6,815,608 oz. for the Tintic district and 11,649,961 oz. for the State. The gold output of this district in 1919 was 25,900 oz.; lead, 24,842,544 lb.; copper, 2,254,848 lb.; and zinc, 93,571 pounds.

The shaft being sunk at the property of the Pinion

MAP SHOWING JEROME, ARIZONA, AND BRANCH ROADS CONNECTING IT TO THE MAIN LINES

Queen Mining Co. has reached a depth of over 800 ft. The rock now being taken from the bottom of the shaft contains some silver and resembles the formation which lies just above the big ore deposits in the Tintic Standard. The East Warm Creek Irrigation & Canal Co. has filed suit in the District Court of Utah county against the Tintic Standard. The plaintiff asks that the defendant be enjoined from the use of the waters of Warm springs and Warm creek, situated about three miles east of Goshen, near the site of the mining company's new concentrator.

Big Cottonwood Canyon.—At the property of the Howell Mining Co. development work is being pushed steadily. A deep tunnel was started to gain 325 ft. of depth. Recently this tunnel encountered a fissure in the quartzite in which a seam of galena occurs. It is not believed that the present find is connected with the deposits in the upper workings, but a survey is being made to determine the question. The Tar Baby Mining Co. is steadily developing on property adjoining the Cardiff. Some time ago the Tar Baby company drove an upper tunnel, which was all in quartzite and a raise through the quartzite encountered shale, as did a similar raise in the Cardiff property. The lower tunnel was driven in limestone, from which an incline raise has been made. This raise is 30 ft. vertically above the tunnel floor and is in a brecciated limestone with considerable mineralization. At the Cardiff mine, production is being maintained at 65 or 70 tons per day, averaging $50 per ton. This ore is being mined from the 600-ft. level workings, and from the 800 and 900-ft. level workings, which were recently unwatered.

Park City.—Ore shipments from this district for the week ending October 2 totaled 2153 tons, of which the Ontario shipped 704; Silver King Coalition, 544; Judge M. & S., 422; Daly-West, 230; Naildriver, 180; and Keystone, 60.

Alta.—An assessment of 1c. per share has been levied by the Woodlawn Copper Co. on all outstanding stock. The assessment is delinquent November 16 and the sale date will be November 30.

Washington County.—The right of escrow expiring on June 1, 1921, held on the property of the Silver Reef Consolidated Mines Co., was taken up on September 30 by the McQuatters Corporation of New York. The property is about 20 miles from St. George, and the ore deposition is unique in that it is in sandstone. According to the U. S. Geological Survey, the value in the ore in the upper workings is practically all in cerargyrite, or hornsilver. Some parts of the vein contain copper carbonates in small amounts. The finding of a yellow uranium-vanadium mineral resembling carnotite, has been reported. In the shaft, about 250 ft. deep, officials report that sulphides have not been found. The ore occurs in beds from 2 to 17 ft. thick, and can be economically mined and transported to the mill. Ore was first discovered at this property in 1875, and by 1880, it is stated that the value of the output was $3,243,740. Operations ceased in 1897 and were resumed in 1902. In 1909 the property was closed down and has remained idle until last summer, when the present owners resumed operations. Estimates vary as to the value of the production to date, although V. C. Heikes of the Geological Survey gives the output to the close of 1909 at 7,211,463 oz. valued at $7,987,112. The tailing dump on the property is estimated to contain 150,000 tons, averaging about 6 oz. in silver per ton. Officials of the new company are Frank C. Morehouse, of New York and Salt Lake City, president; A. J. McQuatters, of New York, vice-president; Richard F. Parker, of New York, secretary-treasurer; Alex Coldbath, of Salt Lake City, general manager. It is stated that a milling-plant will be constructed in the near future. According to engineers' reports, there is developed approximately two million tons of ore, which will average 10 oz. silver and 1% copper per ton.

BRITISH COLUMBIA

THE CONSOLIDATED M. & S. CO. ASKS FOR A HIGH TARIFF ON METAL IMPORTS.

Princeton.—The West Kootenay Power & Light Co.'s high-power line from Bonnington Falls, by way of Greenwood to Copper Mountain, has been completed, tested and proved satisfactory, and the power is now connected, so in all probability the Canada Copper Corporation will start operations at Copper Mountain and at Allenby shortly. The line is 190 miles long, and is believed to be the longest transmission in western Canada; it has a capacity of 110,000 volts, but until more power is required will be operated at 60,000 volts.

Invermere.—An interesting piece of blasting was done recently at the Bunyan mine, under supervision of E. J. Fader, general manager for the Silver Ores, Inc., which owns the property. The mine is situated on a hill-side, about five miles from here; the orebody being in places more than 100 ft. It was decided to change the mode of operating it from underground working to open-cut, or quarry work. With this end in view a cross-cut was driven for 60 ft., a drift run 20 ft., at the end of which a 20-ft. shaft was sunk. The shaft and drift were charged with 60% dynamite, well tamped, and exploded. The blast was a complete success, and an immense body of ore broken, estimated at between five and ten thousand tons. When this has been removed it will form a starting place for quarrying operations.

Atlin.—The question of the ownership of the Engineer group of mineral claims, Atlin district, will be brought before the courts for decision. The property is valued at more than $1,000,000.

Stewart.—The policy of the Provincial government in grub-staking returned soldiers has not been without result in the Portland Canal area. In the vicinity of Tide Lake, about twelve miles from Long Lake, such parties have uncovered a number of narrow high-grade veins of silver-bearing minerals, some of the samples from which assayed as high as $700 per ton. George Clothier, government mining engineer, has recently returned from an inspection of the Bear River region, which suffered most from the heavy rains last summer.

Prince Rupert.—The Graham Island Oil Development Co. has been organized for the exploration of lands [illegible] staked on Graham Island of the Queen Charlotte group. The company claims to have four sections, staked before the War, comprising 2560 acres.

Hazelton.—A contract has been awarded for the continuance of the tunnel of the Cascade group on mineral claims on Hudson Bay mountain for an additional 100 feet.

One of the properties inspected by John D. Galloway, resident mining engineer, is the mica property owned by the Mica Syndicate of Tete Juane Cache and Calgary, the holdings of which are situated on Mica mountain in Eastern British Columbia. There are five claims. Some adjoining crown-granted claims are owned by New York interests. Work was started by S. E. Beveridge, in May of this year. The dominating rock of Mica mountain is described as a coarse-grained garnetiferous mica-schist. The schists are intruded by granite varying from normal granodiorite to pegmatite and these pegmatite dikes contain the mica which is of the muscovite variety. There are crystals or 'books' ranging from 4 by 4 in. to 12 by 12, and still larger are found.

TRAIL.—The attitude of the management of the Consolidated Mining & Smelting Co. with respect to protection against metal imports has been presented to the Canadian Tariff Commission. J. J. Warren, president of the company, complained of the removal of the 7½% war-tax, asserting that, in the confident belief that this impost would remain in force, the company had made investments of a substantial character. Over $250,000 had been expended in developing fluorspar deposits and commitments of equal amount had been assumed in the construction of a rod-mill and other additions to the plant at Trail.

The company's output in lead was 100 tons, about equal to the Canadian consumption. Until 1919 the Canadian tariff was the normal 15% plus the 7½% war-tax as against a United States rate of 25%. Last year the whole was removed and a specific duty of 1c. per pound imposed. The lead producer in this country is seriously menaced by lead produced in Spain, offered here as a British product. The United States has protection of 2c. per pound and notwithstanding was faced with competition from Mexico, Germany, and Spain via England. The exchange situation presented another difficulty in competing with foreign countries.

Mr. Warren said that the industries were overburdened with taxes. The Province took 10% of their gross income, less certain deductions which did not include depreciation of mine property or take into account money borrowed by the company outside the Province. The company had paid in 1919 $150,000 in taxes, over 16% of its net income. Half a million of the 10% dividends had been taken from reserve funds.

During the last nine days of the month of September, 12,744 tons of ore and concentrate was received at the smelter, bringing the total for the first nine months of this year to 257,774 tons. The Consolidated company's mines provided 11,549 tons of the shipment, the other contributers being: Emerald, Salmo, 33 tons; Florence, Princess Creek, 95; Iron Mask, Kamloops, 45; Josie, Rossland, 448; Monarch, Field, 78; North Star, Kimberley, 224; Paradise, Athalmer, 57; Providence, Greenwood, 47; Queen Bess, Alamo, 40; Sally, Beaverdell, 37; Twin, Princess Creek, 26; Velvet, Rossland, 28; and Washington, Sandon, 37.

HOLLINGER CONSOLIDATED GOLD MINES, LTD., ONTARIO

The Trail board of trade submitted to the Commission a memorandum emphasizing the importance of adequate protection to the Trail smelting industry. While there were only between 2000 and 2500 men actually employed at the smelter it was argued that at least 20,000 people were dependent on the successful operation of the plant.

SILVERTON.—The statement of the Standard Silver-Lead Mining Co., operating the Standard mine, near Silverton, Slocan district, shows a cash surplus of $367,996 on July 31 last as compared with $341,825 on March 31, 1920, and $298,010 on December 31, 1919. Profit for June of this year was $10,952.

VICTORIA.—Among the recently incorporated British Columbian companies is the Lowox Steel Co., with an authorized capital of $500,000 and head offices in Victoria. Its business is described as steel makers, colliery

owners, and operators and along other lines of the iron and steel manufacturing industry. Returned soldier prospecting-parties, grub-staked by the Government, have recorded promising copper prospects on Mount Diadem, near Jervis inlet, lower mainland of British Columbia.

ONTARIO

COBALT AN IMPORTANT ITEM IN ONTARIO ORES.

PORCUPINE.—Shortage of labor continues to curtail the output of the mines. Although large numbers of laborers are returning only a small proportion of them go to the mining camps; mine managers, however, expect that before winter sets in they will be able to obtain all the labor they require. The Hollinger Consolidated and the Dome Mines, after having each purchased a carload of the low-grade cyanide for the purpose of testing it, continue to use the imported high-grade cyanide.

KIRKLAND LAKE.—The Lake Shore during August treated 1281 tons of ore with a recovery of $35,261, the falling off in tonnage being due to the breaking of a ball-mill clutch and the re-lining of the mill. Production has now passed the million-dollar mark, the total to the end of August being $1,011,579. Station timbering has been completed at the 400-ft. level and good progress is being made with the sinking of the shaft to a depth of 800 ft.

Surface exploration on the Granby-Kirkland has been completed and actual mining operations begun. A shaft is being put down on vein No. 4, one of the most highly mineralized of a series of eight veins. It is over 4½ ft. wide and gives encouraging assays. A mining plant will shortly be installed.

COBALT.—Three narrow high-grade veins have been opened on the surface at the Kerr Lake mine. They range in width from one to two inches and contain from 2000 to 6000 oz. silver per ton. The first vein was discovered while excavating for the foundation of a crusher, the second was found while extending the excavations so as to provide clearance for a conveyor, and the third was found while preparing a foundation for the motor which is to drive the crusher and conveyor. The veins occur within eight feet of each other, and are in the conglomerate which is 100 ft. thick at this point. The find ranks among the most important surface developments in recent years in Cobalt.

Following the discovery of high-grade ore at the surface of the Kerr Lake mine, the Crown Reserve has placed two machines on an upper level cross-cutting the line of strike of the veins which are about 90 ft. from the Crown Reserve boundary and which run south-east into Kerr Lake by north-west toward the Crown Reserve.

Nearly five tons of high-grade ore has been taken out by open-cut work on veins of the Cane Silver Mines, in Cane township, in the Elk Lake district. The ore will average more than 500 oz. per ton.

The Nipissing Mines Co. has purchased the iron property of the Magnetite Mines Co. situated about 60 miles from New York, with ore-reserves estimated at many millions of tons. The price of the property and the cost of erecting a plant will, it is understood, entail an outlay of over $1,000,000. The ore is stated to run about 37% iron. Peterson Lake is again coming to the front as a producer, shipping about 20 tons of ore daily in addition to the re-treatment of its tailing at the Dominion Reduction mill, which yields a fair profit. An extensive underground exploration program is being carried out. With the increase in the price of cobalt metal to $6 per pound (from $3 to $4 in the rough state) its recovery as a by-product of the silver mines becomes an important source of revenue. The cobalt content of shipments from the mines if over 4% is paid for at the rate of 2 to 4 cents per unit according to the grade of the ore. For instance, shipments comprising 5% cobalt metal are paid for at the rate of 10c. per pound, and the higher-grade cobalt of 10% is paid for at the rate of 20c. per pound. The smelters at Thorold and Deloro are equipped for its recovery, which adds materially to their revenue. The rise in cobalt is stimulating interest in the South Lorrain district where the veins carry a large amount of this metal.

YUKON

GOLD PRODUCTION SMALL OWING TO THE DRY SEASON.

DAWSON.—The last boat of the season left this city for Fairbanks on September 26, which is a sign that the season is rapidly drawing to a close. On the whole it has been disappointing. The gold output will be markedly less than that of last year; the reason for which is the unusual dryness of the past summer, and consequent lack of water for washing the ground that has been mined. At many properties there are large dumps of earth that have been mined, but will have to remain until next year before they can be washed. Consequently next year's output will have the credit for much of this season's work. An important gold strike has been reported from Chandalar, near Fort Yukon, which the early enthusiasts describe as being likely to rival the Klondike. Such reports are not infrequent, and until further details are obtained no idea of the value of the new strike can be given. A number of claims have been staked and a trail is under construction. A wireless plant is being erected at Fortymile. O. B. Perry, manager for the Yukon Gold Mining Co., before leaving for the south, said that his company intended to carry out development work at Mayo and install machinery that would mean a capital investment of half a million dollars. Ore is being moved by tractors from the company's mines to Mayo Landing, and it is expected that it will be transported to seaboard before the winter stops navigation. The Yukon Silver Mining Co. has decided to erect a concentrating-plant at Keno Hill, and the heavy machinery for it will be hauled in over the snow this winter. The Fortymile Power & Dredging Co. has done a large amount of drifting on Dennison fork, but has not had sufficient water to wash the ground. The company is doing a lot of exploration, which will be continued through the winter, and it expects to have enough ground for one or two dredges blocked out by next spring. E. P. Barrall, of the Canadian Klondyke company, states that his company has enough ground to keep it busy for the next decade.

THE MINING SUMMARY

CALIFORNIA

Amador County.— The best ore found in the Old Eureka mine since its acquisition by the present owners is reported on the 3500-ft. level of the property. A large vein of milling-ore has been opened on the 3050-ft. level of the Plymouth Consolidated group at Plymouth, owned by the W. J. Loring syndicate.

Nevada County.—The commissioner of the General Land Office has granted the application of the Golden Center of Grass Valley Mining Co. for the Roche Rock claim located by it within the townsite limits. Good progress is being made in re-opening the Red Ledge mine in the Washington district, according to Lewis Hind, who was here recently. A big shoot of milling-ore has been cut in the lower tunnel and is being developed. Starting up the new mill at the Grass Valley Boundary mine has been delayed a few days by the decision to install a concentrator purchased from the Champion plant near Nevada City before beginning operations.

Litigation involving the Black Bear mine will end in November, and soon thereafter steps will be taken to re-open the property. This is the announcement of William Bucholtz, the principal owner, who has just returned from Oklahoma. Bucholtz, as general manager, brought suit to recover money advanced by him and for salary, and it is expected the title will be confirmed to him within a short time.

Plumas County.—Representatives of the Guggenheim company were in Johnsville last week negotiating for the purchase of the Plumas Eureka mine. This mine was located in 1850 and sold in 1871 to the Sierra Buttes Co. of London. It was closed down in 1897. In 1909 it was bought by the Plumas Eureka Mining Co. The property, which is situated on the east slope of Eureka peak, is 2500 acres in area and includes timber rights. The mine is not being worked at present.

Shasta County.—The United States Smelting, Mining & Refining Co., owner of the Mammoth mine and smelter, has bought the Holt & Gregg Co.'s lime quarry, lime kilns, electric railroad from works to quarry, and all buildings in Kennett for $20,000 according to the revenue stamps on the deed. An electric railroad 2½ miles long connects the lime quarry with the smelter. The purchase of the property is taken to indicate an early resumption of smelter operations.

The Shasta Exploration Co. is contesting the issuance of patents to the United States Smelting, Refining & Mining Co. (Mammoth Copper Co.) for the Wren, Crow, Coon, Last Chance, and Comstock mining claims in the Backbone district near Kennett. The Shasta Exploration Co. holds that all or a portion of these claims conflict with the boundaries of its Eva Lode, Carrie Alice, Vernie, Diamond Fraction, and Six Point mines. The action will be tried in the Superior Court before patents can be issued to either company.

Sierra County.—Five hundred pounds of specimen gold ore has been taken from the Tightner mine during the last few days. This is according to the report reaching here. The Tightner, at Alleghany, has long been noted for its rich pockets. It is stated that the discovery was made in a tunnel at a point only 18 ft. from where work was abandoned by the former operators. The property was taken under bond by a company of mining men several months ago and Fred Searles is in charge as superintendent.

COLORADO

Breckenridge.—Mines and dredges in this district are operating short handed. High-grade silver ore is coming from the Gold Bond on Mount Guyot, operated under lease. The Horn mine in the same section, long idle, has been opened. The Brooks-Snider Schock Hill is again producing high-grade ore; 14 sacks mined by lessee Ange contained 168 oz. gold per ton. The Morgan lease is shipping silver ore of $45 to $70 grade from the same mine. Wellington Mines paid its 19th dividend, amounting to $100,000, early in the month.

Cripple Creek.—The Portland Gold Mining Co. will pay the regular quarterly dividend of 1½c. per share, amounting to $45,000 on October 20 to stockholders of record of October 12. Lessees of the United Gold Mines Co., on the Hardwood claim of the Damon group, Ironclad hill, continue production of high-grade ore.

Denver.—Manganese ore from California, Montana, Nevada, and old Mexico is being received by the Ferro Alloy

WINTER HOOD ON STACKER OF YUKON DREDGE AT MURRAY, IDAHO

company of this city and ferro-manganese is being manufactured to the extent of 200 tons monthly.

Georgetown.—Lessees on the Waldorf are mining and shipping smelting-grade ore. Last week's shipment brought $75 per ton. The Backbone lessees are shipping milling-grade ore to the Wasatch mill and Mount Helen mine lessees are also shipping milling-ore. The force at the Georgetown tunnel has been increased and a good grade of ore is being sent to the concentrator.

Leadville.—Austrian lessees on the Little Jonny continue shipping high-grade from the Breece Hill mine, and are now drifting into virgin ground. The estimated value of the ore shipped to date by lessees exceeds $300,000. Operations have been resumed on the Tucson claim of the Iron Silver Mining Company.

Silverton.—The Hanson Peak Mining Co. has acquired the Independence and Malone claims formerly owned by the Finney Jones estate. The property adjoins the Sunnyside mine, and Pete Holmgrain, the manager, is mining ore averaging $40 per ton. Eastern interests, with G. H. Bibb

in charge, have taken over the Eastern Star. Equipment and supplies have been sent in for operation during the winter.

Telluride.—Shipments of concentrate during September were 33 cars from the Smuggler and 31 from the Tomboy. The Liberty Bell mill shipped 4 cars.

IDAHO

The Carbonate Mining Co. plans to start development work in the near future. The company owns a group of claims near Beeler in the Pine Creek district of the Coeur d'Alene. The Jim Blaine and Bristol properties in the Pine Creek district tributary to Kellogg have been merged into the Jim Blaine Silver syndicate. The Jim Blaine property is located a half-mile from the main works of the creek. Surveys for the new tunnel which is to be driven from the creek level to cut the Bristol and Jim Blaine veins have been completed. Contracts for 400 ft. of additional work in the cross-cut on the Slavonian Mining Co.'s property in Wardner have been let. The cross-cut is now 900 ft. long and is expected to reach the vein at 1200 ft., leaving 300 ft. yet to run. The present contract calls for a drift on the vein, should it be reached before the 400 ft. is completed. The Nabob mine on Pine creek, in the Coeur d'Alene, will join the regular shippers according to reports. The raise connecting the lower and upper workings has been completed and other details worked out for the economical handling of ore from the mine to the mill. All the ore-bins at the mill are full of ore and ore is broken in four stopes in the mine, ready for movement to the mill. A station has been cut at the top of the raise and a hoist installed. A crew of 60 to 75 men will be employed underground and in the concentrator. Plans for constructing a 100-ton mill for the Jack Waite property near Wallace have been made and ore is being transported by two motor-trucks from the mine to Prichard, a distance of 13 miles. Shipments are averaging 55% lead.

NEW MEXICO

Pinos Altos.—The shaft-house of the United States Copper Co. near here was destroyed by fire during the past week. The origin of the fire is unknown. The contents of the office, which was in the building, were destroyed, something that will naturally cause a great deal of inconvenience as well as loss, but it is believed that the machinery in the building was not seriously injured. Several new claims have been located in the south-eastern part of the district and assessment work is being done, preparatory to further development. One of these properties known as the Clint is an old-time producer, but on account of the low price of silver was abandoned several years ago. A new shaft is being sunk, and the old shaft re-timbered so that operations may be carried on through both shafts.

Silver City.—The New Mexico Mining Association met Monday afternoon, October 4, for the purpose of perfecting their organization as the New Mexico Chapter of the American Mining Congress. John M. Sully, manager for the Chino Copper Co., acted as chairman of the meeting. About seventy operators and mining men from all over the State assembled and held an enthusiastic meeting.

White Signal.—Development work on the radium-bearing ore deposits at White Signal has been discontinued. It is understood that the trouble is due to the difficulty of perfecting a system of separation of the metals from the torbernite ores, which are said to differ considerably from any being used for the production of commercial radium at this time. The Radium Co. of Colorado, which was interested in the deposits, has had an expert on the ground for several weeks. During the progress of the development work the mineral was found at a number of different points; most of the work, however, was done through the Merry Widow shaft, which had been sunk to considerably over 200 ft.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Henry Krumb is at Superior, Arizona.

J. B. Tyrrell writes from Newfoundland.

A. W. Allen has left Peru on his way to London.

L. A. Butler left New York last week for West Africa.

Albert Turner has left London to go to Oatman, Arizona.

C. M. Weld has removed his offices to 2 Rector street, New York.

Howard D. Smith was in San Francisco last week; he is now at Ely, Nevada.

Horace G. Nichols was here last week on his way from Mexico to British Columbia.

W. Pellew-Harvey has left Vancouver on his return to London by way of New York.

John E. Bergh, of the firm of Sturtevant & Bergh, of Salt Lake City, is at Tobar, Nevada.

Ralph J. Baverstock, of Baverstock & Payne, Los Angeles, has been to Calexico, Lower California.

H. Vincent Wallace, of Los Angeles, passed through San Francisco on his way to Eureka, Nevada.

L. V. Waterhouse has been appointed general manager for the Mount Hope company, in New South Wales.

E. T. McCarthy has arrived here on his way from London to China. He sails from Vancouver on October 21.

R. C. Gemmell and **D. D. Moffat** are making a tour of inspection of the Ray Consolidated and Chino Copper mines.

Frederic R. Weekes has returned to New York from the Portland Canal and Alice Arm districts, British Columbia.

Solon Spiro, president of the Silver King Con. M. Co., at Park City, Utah, has returned to Salt Lake City from New York.

Y. Fukihara, of the Mitsubishi Mining Co., Tokio, Japan, was in San Francisco last week and has gone to Tonopah, Nevada.

James K. Dickson, recently mining engineer to the Honduras Rosario Mining Co., in Honduras, has arrived in San Francisco.

H. S. Weigall has been transferred from the Seoul Mining Co., in Korea, to become general manager for the Taio Gold Mining Co., at Fukuoka-ken, in Japan.

A. J. Reef, who has been associated with the Salt Lake City office of the United States Smelting Co., has been transferred to the Boston office of the company.

Craig Sandusky, superintendent for the Zuma Mining Co. at Eureka, Utah, has resigned and will go to Colorado. **A. C. Nebeker,** of Milford, Utah, will succeed him at the Zuma.

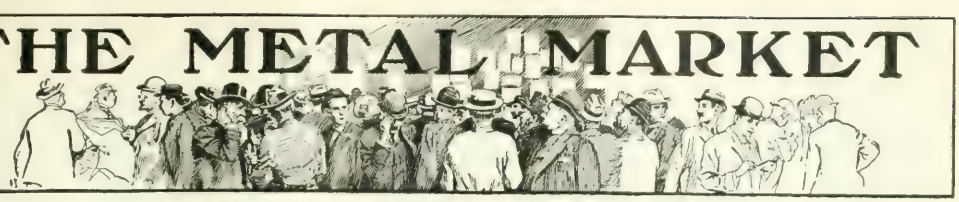
W. M. Thayer, formerly professor of geology at the Ohio Mechanics Institute, has resigned to devote himself to consulting practice in oil and mining geology at Cincinnati, Ohio.

R. E. McDonnell, of the firm of Burns & McDonnell Engineering Co., Kansas City, was elected president of the Southwest Waterworks Association, at the ninth annual convention, in New Orleans, on September 24.

D. C. Jackling left San Francisco on October 1. He visited the Butte & Superior and the Mesabi iron properties, and is now at Hayden, Arizona, inspecting the Ray Consolidated property. After a short visit to the Chino property in New Mexico, he will go to New York.

David A. Herron, manager for the Tomboy Gold Mines Co., at Telluride, Colorado, died at Denver on September 24. He was about to resign on account of ill health; nevertheless the sad news comes as a shock to his many friends.

THE METAL MARKET



METAL PRICES

San Francisco, October 11

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	18.75
Lead, pig, cents per pound	8.00—9.00
Platinum, pure, per ounce	$105
Platinum, 10% iridium, per ounce	$145
Quicksilver, per flask of 75 lb	$75
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

October 11.—Copper is stagnant and lower. Lead is quiet and easy. Zinc is inactive but easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence
Oct. 5	89.12	57.62
" 6	88.62	56.87
" 7	87.00	56.12
" 8	87.50	56.12
" 9	85.37	54.87
" 10 Sunday		
" 11	83.00	53.37

Average week ending	Cents	Pence
Aug. 30	96.61	60.70
Sept. 6	93.37	58.90
" 13	93.96	59.15
" 20	94.31	60.08
" 27	93.52	59.66
Oct. 4	91.65	58.98
" 11	86.77	55.66

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.78	Sept.	101.12	113.92	93.66
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	
Oct. 5	18.25
" 6	18.12
" 7	18.00
" 8	17.75
" 9	17.50
" 10 Sunday	
" 11	17.50

Average week ending	
Aug. 30	19.00
Sept. 6	19.00
" 13	18.75
" 20	18.75
" 27	18.70
Oct. 4	18.50
" 11	17.85

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	18.75
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	
Oct. 5	7.50
" 6	7.50
" 7	7.50
" 8	7.50
" 9	7.50
" 10 Sunday	
" 11	7.50

Average week ending	
Aug. 30	8.85
Sept. 6	8.55
" 13	8.29
" 20	8.06
" 27	7.85
Oct. 4	7.54
" 11	7.50

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	8.08
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	44.43
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	
Oct. 5	7.65
" 6	7.60
" 7	7.55
" 8	7.50
" 9	7.50
" 10 Sunday	
" 11	7.50

Average week ending	
Aug. 30	8.45
Sept. 6	8.29
" 13	7.78
" 20	7.83
" 27	7.73
Oct. 4	7.66
" 11	7.55

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	7.84
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	
Sept. 14	75.00
" 21	75.00
Sept. 28	75.00
Oct. 5	75.00
" 11	75.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	75.00
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

METAL MINING IN SEPTEMBER

Stagnation in metal mining is reported by the Federal Reserve Board. Because of the low purchasing power of the metal, the gold output in California and Nevada continues to decline. Silver mines in Utah and Idaho, however, are working on a basis which will probably be slightly ahead of 1919. Copper production in Arizona will probably exceed that of 1919, but elsewhere there is no change. The lead output of Utah and Idaho has been small, but some idle mines are resuming operation with prospects of production exceeding 1919. Recent freight-rate increases have produced discouragement, and greater costs of supplies may further lower production. Zinc and lead have shown improvement in volume shipped and price paid. In Missouri, Oklahoma, and Kansas, zinc-ore shipments increased 20% and lead 12% in August over July. Stocks, however, increased 2000 tons. Car shortage is a serious problem in ore shipments, while new freight-rates will increase the cost of slab zinc by $4 per ton.

The Comptroller of the Treasury has ruled that the director of the Mint may purchase Alaskan silver at $1 per ounce under the Pittman law, as Alaska is a part of the United States within the meaning of the law. Silver produced in the Philippine Islands, however, cannot be purchased under the Act, the Islands not being a part of the United States within the meaning of the Act, as United States laws do not generally apply to the Philippines. During the past week the Director purchased 432,000 oz. of silver, a total to date of 1,340,371 ounces.

According to W. F. Bartholomew, of Tucker, Bartholomew & Co. and a director of Seneca and North Butte mining companies, the copper situation is not quite as bad as generally supposed. Surplus stocks have declined since the first of the year and the next 30 or 60 days should see a resumption of metal buying, in his opinion. He says: "There has been abnormal delay in the purchase of copper by reason of the credit situation and the general desire on the part of manufacturers to reduce inventories to the minimum and this situation has been more pronounced because of the absence of European buying. Now in the absence of buying and an increase of stocks, prices have naturally been affected, especially in the face of the recent re-sale of copper sold to Japan but not shipped. Copper has been sold recently as low as 17½c. per pound.

"Copper was the first commodity to be liquidated and is now down to a price which causes mines to restrict rather than produce. Deliveries from the last large sale of copper are just being concluded and new buying will soon have to take place. Stocks of copper on January 1, 1920, were 733,000,000 lb. On September 1 total stocks in this country were 577,000,000, or 156,000,000 lb. reduction in stocks from January 1 figures. Total sales in September were about 60,000,000 lb. Now Europe is bare of copper and domestic consumers' stocks are at the minimum so that the producers have the copper, and I maintain that under these conditions a healthy buying movement is due and there is no just basis for pessimism. In fact, I look for a pronounced change in the copper-metal outlook during the next 30 or 60 days."

MONEY AND EXCHANGE

Foreign quotations on October 11 are as follows:

Sterling, dollars:	Cable	3.51
	Demand	3.51¾
Francs, cents:	Cable	6.67½
	Demand	6.68½
Lire, cents:	Demand	4.05
Marks, cents		1.59

Eastern Metal Market

New York, October 6.

All the markets are exceedingly inactive and in some the situation is not satisfactory or bright. The general nation-wide tendency to lower prices is having its effect in the metal markets, which are all at low levels, in some cases down to cost of production.

Copper buying is almost nothing and prices are largely nominal.

The tin market is lower and very quiet.

Lead has again declined with imported metal the predominating influence.

The zinc market is unchanged and very dull.

Antimony is a little lower.

IRON AND STEEL

The iron and steel markets are but little changed since last week. Buying is light and the tone is easy. Some see a slight improvement. Pittsburgh prices are firm at last week's levels. In general, however, the tendency is downward, but gradually so. Pig-iron is lower, with foundry even down $3 to $47. The key to the iron situation is the price of coke, which is still very high. Makers cannot be shown how pig-iron can come down with coke still very stiff. Production of coke is steady. There is a belief that the steel market will soon enter a more competitive condition with independents' prices nearer or close to those of the Steel Corporation. Billets have declined to $50, as compared with a recent level at $60. The sheet-bar market is off to $65 to $70. The steel-plate market is softening. All these refer to the outside or independent market.

The September pig-iron output was 3,129,323 tons, or 104,310 tons per day compared with 3,147,402 tons in the 31 days of August, or 101,529 tons per day. The September rate was the highest since February 1919, excepting March of this year. October is likely to exceed September in production. Eighteen furnaces were blown in during September and 10 were shut-down; the estimated capacity of the 319 furnaces active on October 1 was 106,220 tons per day, against 104,265 tons per day for 311 furnaces one month previous.

ANTIMONY

The market is extremely quiet and lower with wholesale lots for early delivery quoted at 7c., New York, duty paid. Jobbing lots are quoted at 7.25c.

ALUMINUM

There is a wider divergence between the outside market and the leading producers. Wholesale lots of virgin metal, 98 to 99% pure, for early delivery are quoted at 34.90c. f.o.b. producers' plant, by the leading interest, but at 28 to 29c. per pound, New York, by other sellers, handling largely foreign metal.

COPPER

There is no improvement in the situation. Consumers are still uninterested and buying is at low ebb. There has been no discernible change in the price situation, quotations being largely nominal in the absence of transactions in any volume. Most of the leading producers still adhere to a quotation of 18.75c., New York, for both Lake and electrolytic copper for October delivery, but are doing little if any business. There is strong talk of further curtailment of production. Costs are higher and prices weaker and it is argued that it is better business to leave the metal in the ground. The outside market is quotable around 18.50c., New York, as an average, though there may be small lots available at less than this. The British market was lower early last week but strengthened with more favorable strike news.

LEAD

The feature of the market was another reduction on September 29 of ¼c. per pound by the American Smelting & Refining Co. This makes the third reduction since September 13, the total amounting to 1¼c. per pound. The new quotation is 7.50c., St. Louis, or 7.75c., New York. The outside market remains unchanged in conditions, being still ruled by the imported metal, which is offered at 7.50c., seaboard, for October delivery. In September the imports were 7630 tons, which is not heavy, relative to consumption, but which is influential under present market conditions. Demand is light, with buyers maintaining a waiting attitude, apparently expecting lower prices.

TIN

Up to the end of last week the market was almost at a standstill, although prices had settled to an attractive level. Consumers, however, were not interested and still show no interest. In fact some were offering to sell tin in isolated cases. There were really more sellers than buyers. Pessimism has even been apparent, but it is now believed by many that the worst is past. Early this week there has been a little more interest, largely by dealers who seem to be ready to pick up bargain lots, particularly for Eastern shipment. On Monday on the New York Metal Exchange 50 tons of October-November shipment was sold at 42.75c. and more could have been sold had there been sellers. Spot tin was reported offered at 42.50c., but not confirmed.

ZINC

The situation is materially unchanged. In the Eastern market imported metal is the dominant factor, while in the West the situation is characterized by lack of demand and lower output. Prime Western for October delivery in the East, based on imported metal, is quoted at 7.65c., New York, while the same grade at St. Louis is held at about 7.65c., or 8c., New York. There is very little buying except to cover consumers' immediate needs, either in the East or at St. Louis. Prices are therefore more or less nominal at 7.65c. for October delivery at New York or St. Louis.

ORES

Tungsten: Inactivity pervades the market. There has been some inquiry but no business is recorded. Consumers are apparently uninterested at least. Quotations are unchanged at $4.50 per unit for some Chinese ore and high-grade foreign ores are held at $5 to $6 per unit.

Ferro-tungsten is unchanged at 80c. to $1.05 per pound of contained tungsten.

Molybdenum: The market is entirely dead with quotations nominally unchanged at 65 to 75c. per pound of MoS_2 in regular concentrates.

Manganese: The general situation is unchanged. Consumers are well stocked and are not buying. There have been offerings of Indian and South American ores but no sales. Quotations are 60 to 65c. per unit, seaboard, but buyers are not interested above 55c. per unit. Imports in August are returned as 99,601 gross tons, or the heaviest of any month this year. The total to September 1 is now 334,590 tons, as compared with 249,810 tons to September 1, 1919.

Manganese-Iron Alloys: The market is still inactive with quotations for ferro-manganese unchanged at $170, basis seaboard, for either foreign or domestic alloy and for spiegeleisen at $82.50, furnace, for the higher grade and $80 for the lower. Some re-sale ferro-manganese is reported to have changed hands at $160 to $165. Imports of ferro-manganese in August were 9804 tons, the heaviest in any month this or last year.

Book Reviews

The Mining Laws of the British Empire and of Foreign Countries. Vol. I. Nigeria. By Gilbert Stone. 250 pp. Published for the Imperial Mineral Resources Bureau. For sale by the 'Mining and Scientific Press'. Price, $4.

This is the first of a series of publications intended "to provide an up-to-date and authoritative exposition of the mining laws in force in different parts of the world, available both for the legal profession and for all those who are in any way interested in mining and minerals". The next volume will deal with the Gold Coast of West Africa and the third with the Transvaal. We welcome these publications in behalf of the mining profession.

Hydraulic Tables. By Gardner S. Williams and Allen Hazen. Third edition. Pp. 115, ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $2.

The principal change as compared with the second edition of this book is the inclusion of the chapter on 'Additional Data', in which are discussed the results of the principal experiments on the flow of water that have been made in the 12 years since the appearance of the second edition. Various tables and other data on the flow of water through pipes and other passages, based on the Hazen-Williams formula comprise most of the book. There is also a division devoted to the flow of water over weirs. The book will be useful to the hydraulic engineer.

Steam-Shovel Mining. By Robert Marsh, Jr. Pp. 258, ill., index. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, $3.50.

This book was apparently written for engineers and will be found particularly useful by all of that profession who are engaged on any work in which excavation of earth and rock plays an important part and it will prove equally useful for the manager and superintendent. Detailed descriptions of the different types are compared; modern methods of mining involving the use of power-excavators are described and there is much information covering the costs of operation. This, as everyone knows, is a particularly difficult task at the present but the author has tried to accomplish it by giving the unit factors at the time of writing and also under pre-war conditions. It is a valuable book.

Ten-Minute Talks With Workers. Pp. 208. Doubleday, Page & Co., New York. For sale by 'Mining and Scientific Press'. Price, $1.

This is a series of 40 short articles from various issues of the Trade Supplement of the London 'Times', the wording being changed occasionally to suit American readers. Each article is a brief discussion of some subject connected with political economy, expressed in language suited to the man in the street and in the shop, but without any atmosphere of 'talking down' to the audience. In fact, the book might be called an anti-Bolshevik tract, and, as far as the reading matter is concerned, it is a good one. However, binding, printing, and other mechanical features are of such quality that the price is necessarily too high for a tract. The man that really needs to read the book will not pay the dollar for it, and employers and others can hardly afford to arrange for free distribution.

Practical Chemistry. By N. Henry Black and James Bryant Conant. Pp. 474, ill., index. The Macmillan Co., New York. For sale by 'Mining and Scientific Press'. Price, $2.

This book does not require the author's preface to tell one that it is intended as an elementary textbook for use in the public schools. It is written in 'popular science' style and therefore will doubtless be interesting to many young people, a sugared pill of knowledge, but, for our own part, when we have wanted information from textbooks we preferred it, like cascara, 'straight'. The book aims to include industrial chemistry and chemical engineering in its field but the difficulty of covering this field is indicated by the illustration of 'A Stamping Mill' and the statement concerning the ore of the Lake Superior region that "In order to isolate 'native copper' it is necessary only to grind the rock to powder and then to heat it until the metal runs together and flows to the bottom of the mass".

Mine Bookkeeping. By Robert McGarraugh. Pp. 118, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by the 'Mining and Scientific Press'. Price, $2.

It is a pleasure to see a book that, as the author states, has been prepared to supply a real need. It is intended for the engineers, superintendents, and operators of small mines. The present courses of instruction for engineers make little provision for education in business principles or in office routine and the average engineer is apt to take the returns from the office as gospel without appreciating the necessity of having all data properly collected and arranged, if trustworthy results are to be had, or to go to the other extreme and discard the office-prepared data and make up his own at a considerable loss of time, effort, and accuracy. Although the book is small and the author does not go into detail as much as is done in books intended for professional accountants, the technical man who lacks office experience and many others will find it useful.

Design of Highway Bridges. By Milo S. Ketchum. Second edition. Pp. 538, ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $6.

Changes in highway-bridge practice during the 12 years since the first edition of this book was published, particularly the increase of live loads and the growing use of reinforced concrete, have made necessary its revision and the almost complete re-writing of some parts. The scope of the book has also been extended so as to cover both concrete and timber bridges as well as steel. Part I discusses the calculation of stresses in the various bridge members. Part II covers the design of steel and of timber highway bridges, while Part III covers reinforced concrete bridges and foundations. In Part IV, various details of bridge design, contracts, estimates and costs, and bridge erection are considered. There are three appendixes, the first covering specifications for steel bridges, the second, specifications for concrete bridges, and the third contains various structural tables. The book will be indispensable to anyone engaged in the design or the construction of highway bridges.

Personnel Administration. By Ordway Tead and Henry C. Metcalf. Pp. 520, ill., index. McGraw-Hill Book Co., New York. For sale by 'Mining and Scientific Press'. Price, $5.

The systematic study of industrial relations and the development of the technique of personnel management are so new that the literature of the subject is scanty, and much information is only to be found scattered through periodicals and official reports. The present volume is a fairly successful attempt to collect the most important of these data under one cover. That it is, in many places, too much colored by the authors' personal preferences regarding matters in dispute was, perhaps, unavoidable. Nevertheless, the book will be of value to the employer, the personnel manager, and to others interested in the subjects of which it treats. The scope of the book is best indicated by the section-headings, which are The Personnel Department; Em-

ployment Methods; Health and Safety; Education; Research; Rewards; Administrative Correlation; and Joint Relations (between employer and employee).

Recent Publications

The Safe Storage of Coal. By H. H. Stoek. Tech. Paper 235, Bureau of Mines, 1920. Pp. 9.

Potash Deposits in Spain. By H. S. Gale. Bull. 715-A, U. S. Geological Survey, 1920. Pp. 18, ill.

The Potash Deposits of Alsace. By H. S. Gale. Bull. 715-B, U. S. Geological Survey, 1920. Pp. 41, ill.

Nickel. By F. L. Hess. Advance Chapter of Mineral Resources of the United States, 1918—Part I:25, 1920. Pp. 9.

Perforated Casing and Screen Pipe in Oil Wells. By E. W. Wagy. Tech. Paper 247, Bureau of Mines, 1920. Pp. 48, ill.

Graphite. By Hugh S. Spence. No. 511, Canada Department of Mines, Mines Branch, Ottawa, 1920. Pp. 202, ill., maps.

Development of Liquid Oxygen Explosives During the War. By G. S. Rice. Tech. Paper 243, Bureau of Mines, 1920. Pp. 46, ill.

Feldspar. By L. M. Beach. Advance Chapter of Mineral Resources of the United States, 1918—Part II:30, 1920. Pp. 7, ill.

Cadmium. By C. E. Siebenthal. Advance Chapter of Mineral Resources of the United States, 1919—Part I:1, 1920. Pp. 10.

Accident Prevention in the Mines of Butte, Montana. By Daniel Harrington. Tech. Paper 229, Bureau of Mines, 1920. Pp. 59, ill.

Determination of Molybdenum. By J. P. Bonardi and Edward P. Barrett. Technical Paper 230, U. S. Bureau of Mines, 1920. Pp. 35.

The Properties of Some Stoneware Clays. By H. G. Schurecht. Technical Paper 233, U. S. Bureau of Mines, 1920. Pp. 38, 1 plate.

Use of Stenches as a Warning in Mines. By S. H. Katz, V. C. Allison, and W. L. Egy. Tech. Paper 244, Bureau of Mines, 1920. Pp. 31, ill.

Barytes and Barium Products. By G. W. Stose. Advance Chapter of Mineral Resources of the United States, 1918—Part II:31, 1920. Pp. 18.

Mining and Preparing Domestic Graphite for Crucible Use. By G. D. Dub and F. G. Moses. Bull. 112, Bureau of Mines, 1920. Pp. 90, ill.

Effects of Gasoline Removal on the Heating Value of Natural Gas. By Donald B. Dow. Tech. Paper 253, Bureau of Mines, 1920. Pp. 23, ill.

Magnesium in 1919. By Ralph W. Stone. I:4, U. S. Geological Survey, 1920. From Mineral Resources of the United States, 1919—Part I. Pp. 4.

Coal. Part A: Production. By C. E. Lesher. Advance Chapter of Mineral Resources of the United States, 1918—Part II:27, 1920. Pp. 119, ill.

Casing Troubles and Fishing Methods in Oil Wells. By Thomas Curtin. Bull. 182, Petroleum Technology 57, U. S. Bureau of Mines, 1920. Pp. 48, ill.

Lithium Minerals in 1919. By Herbert Insley. II:3, U. S. Geological Survey, 1920. From Mineral Resources of the United States, 1919—Part II. Pp. 4.

Fuel Briquetting in 1919. By F. G. Tryon. II:2, U. S. Geological Survey, 1920. From Mineral Resources of the United States, 1919—Part II. Pp. 4.

Manganese, Uses, Preparation, Mining Costs and the Production of Ferro-Alloys. By C. M. Weld and others. Bull. 173, Bureau of Mines, 1920. Pp. 209.

The Origin of the Faults, Anticlines, and Buried 'Granite Ridge' of the Northern Part of the Mid-Continent Oil and Gas Field. By A. E. Fath. Professional Paper 128-C, U. S. Geological Survey, 1920. From Shorter Contributions to General Geology, 1920. Pp. 10.

Bauxite and Aluminum in 1919. By James M. Hill. U. S. Geological Survey, I:5, 1920. Pp. 8. From Mineral Resources of the United States, 1919—Part I.

Abrasive Materials in 1918. By Frank J. Katz. U. S. Geological Survey, II:33, 1920. Pp. 17. From Mineral Resources of the United States, 1918—Part II.

Platinum and Allied Metals in 1919. By James M. Hill. I:2, U. S. Geological Survey, 1920. From Mineral Resources of the United States, 1919—Part I. Pp. 10.

Gold and Silver in 1918 (General Report). By J. P. Dunlop. I:24, U. S. Geological Survey, 1920. From Mineral Resources of the United States, 1919—Part I. Pp. 55.

The Mule Creek Oil Field, Wyoming. By E. T. Hancock. Bull. 716-C, U. S. Geological Survey, 1920. From Contributions to Economic Geology, 1920, Part II. Pp. 19, map.

Arsenic, Bismuth, Selenium, and Tellurium in 1919. By James M. Hill. U. S. Geological Survey I:3, 1920. Pp. 9. From Mineral Resources of the United States, 1919—Part I.

Indicators for Carbon Dioxide and Oxygen in Air and Flue Gas. By L. H. Milligan, D. O. Crites, and W. S. Wilson. Technical Paper 238, U. S. Bureau of Mines, 1920. Pp. 23, 3 plates.

Deposits of Iron Ore Near Stanford, Montana. By Lewis G. Westgate. U. S. Geological Survey Bull. 715-F, 1920. Pp. 8. From Contributions to Economic Geology, 1920—Part I.

Geothermal Data of the United States, Including Many Original Determinations of Underground Temperature. By N. H. Darton. Bull. 701, U. S. Geological Survey, 1920. Pp. 96, ill.

Cobalt, Molybdenum, Tantalum, Titanium, Radium, Uranium, and Vanadium. By F. L. Hess. Advance Chapter of Mineral Resources of the United States, 1918—Part I:26, 1920. Pp. 27, ill.

Mineral Resources of the United States in 1919 (Preliminary Summary). Introduction by G. F. Loughlin, Statistics assembled by Martha B. Clark. U. S. Geological Survey, 1920. Pp. 128.

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Gold, Silver, Copper, Lead, and Zinc in Colorado in 1918. Mines Report. By Charles W. Henderson. U. S. Geological Survey, I:27, 1920. Pp. 56. From Mineral Resources of the United States, 1918—Part I.

Mineral Production of the United States in 1917. Introduction by H. D. McCaskey; Summary by M. B. Clark. Advance Chapters of Mineral Resources of the United States, 1917—Part I:C., 1920. Pp. 62, ill.

Geology of the Yellow Pine Cinnabar-Mining District, Idaho. By E. S. Larsen and D. C. Livingston. U. S. Geological Survey Bull. 715-E, 1920. Pp. 11. From Contributions to Economic Geology, 1920—Part I.

Cobalt, Molybdenum, Nickel, Titanium, Tungsten, Radium, Uranium, and Vanadium in 1917. By Frank L. Hess. U. S. Geological Survey, I:29, 1920. Pp. 61. From Mineral Resources of the United States, 1917—Part I.

Clay-Working Industries, Silica Brick, and Building Operations in the Larger Cities in 1918. By Jefferson Middleton. II:29, U. S. Geological Survey, 1920. From Mineral Resources of the United States, 1918—Part II. Pp. 88.

The Ore Deposits of Utah. By B. S. Butler, G. F. Loughlin, V. C. Heikes, and Others. Professional Paper 111, U. S. Geological Survey, 1920. Pp. 669, ill, insert. For sale by Superintendent of Documents, Government Printing Office, Washington, D. C. Price, $1.50.

T. A. RICKARD, - - - - Editor

IN our issue of September 11 a note on 'Lead Production' was credited to the 'Metal Bulletin', whereas we learn now that only the statistics originated with that publication. The information, copied by us from a newspaper, originated with 'The Magazine of Wall Street' of August 21, 1920.

DOMESTIC exports of mining machinery during August, according to the Department of Commerce, amounted to $1,071,845, of which $463,623 was for oil exploitation and $608,222 for other kinds of mining. Of the latter, Mexico took $233,477 and was by far the largest buyer among foreign countries.

OXIDATION of a gold-bearing quartz vein at a depth of 2675 feet is announced from the Lonely Reef mine, in Rhodesia. This condition, it is said, is "connected with the existence of an extensive crushed zone through which the two levels immediately above have been passing". Do any of our readers know of a mine in which oxidation has been found to extend as deeply, or deeper?

BRAZIL is a great mining region; therefore the geology of the country is interesting to mining engineers. As a subject it has gained greatly in human interest by becoming associated with the life-work of John Casper Branner of Stanford University. We are glad therefore to publish an interesting letter in which our friend Mr. F. Lynwood Garrison reviews Dr. Branner's investigations as recorded on his geologic map of Brazil. Mr. Garrison incidentally gives us a good deal of information on the country, which, it will be remembered, can boast, among other things, the deepest mine in the world.

THE New Modderfontein, the greatest gold mine in the world, is doing well. It is on the Rand, in South Africa. We gave an account of its history and resources two years ago and concluded that it was the "greatest" gold mine by reason of its output, profit, and assured prospects. During the financial year ended on June 30 the total revenue of the New Modderfontein Gold Mining Co., Ltd., was £2,555,467. The working cost was £1,061,622 and the working profit £1,493,845. The average yield was 52s. 9d. per ton, which, at $4 to the pound, is equivalent to $10.50 per ton. The working cost was 21s. 11d., or about $4.40 per ton. Dividends for the year amounted to £1,155,000, or 82½% on the capital. Since the commencement of milling in May 1906 the mine has produced 8,681,480 tons of ore yielding 3,962,412 ounces of fine gold, from which £6,033,750 has been paid in dividends to the shareholders. The reserve of ore at the end of June is estimated at 8,869,700 tons averaging 8.4 dwt. per ton over a stoping-width of 67 inches, this being sufficient to supply the mill for seven years. Last year the company received £464,600 in extra revenue thanks to the discount on sterling.

MEXICO is to the front again in a mining way, and we are right well pleased that it should be so. We have published recently several articles on the mining districts of that country and in this issue we give a description of the El Tigre district, which is known chiefly through the successful career of the El Tigre, or Lucky Tiger, mine. The geology of this part of Sonora is rich in variety and in suggestiveness to the student of ore deposits. Mr. R. T. Mishler, the manager of the El Tigre mine, is a technician whose methods are truly scientific in their carefulness and consequent accuracy, so that we can commend the article heartily to mining engineers interested in that part of Mexico.

DR. COTTRELL, it is announced, intends to retire as Director of the Bureau of Mines at an early date, probably in December, in order to give his time to research work as a member of the National Research Council. When he accepted the appointment it was on the understanding that he would serve temporarily, pending the selection of a permanent chief. We understand that Mr. H. Foster Bain, who is now in China, has been approached officially with a view to his appointment. We hope he will accept it, for he is already familiar with the work, having served as assistant to Dr. Manning, and he is admirably fitted in other ways for the directorship.

AT a time when hod-carriers are better paid than schoolteachers, and when therefore first-rate men and women naturally seek other vocations, it is well to recall what Roger Ascham said in 1565, three and a half centuries ago: "It is pity that commonly more care is had, yea, and that among very wise men, to find out rather a cunning man for their horses than a cunning man for their children. They say nay in word, but they do so in deed. For to the one they will gladly give a stipend of 200 crowns by the year and are loath to offer to the other 200 shillings. God that sitteth in heaven laugheth their

choice to scorn and rewardeth their liberality as it should. For he suffereth them to have tame and well ordered horses, but wild and unfortunate children, and therefore in the end they find more pleasure in their horses than comfort in their children." Doubtless the laughter in the heavenly places finds a sardonic echo in complementary quarters supposed to be down below somewhere. Hardly less anomalous is the spectacle of a State that spends millions on a university where its young men and women undergo instruction and some process of education for three or four years only to be debauched intellectually for thirty or forty years by the daily influence of a contemptible press.

LAST week we quoted sundry statistics on immigration. Several causes have joined to check migration from Europe; one of them is the cost of travel. The head-tax in 1882 was 50 cents; it is now $8. Every immigrant has to pay $10 for an American consular *visé* of his passport. In 1913 the total cost, for steamship ticket, consular fees, and head-tax, ranged from $34 to $48, according to the European port from which the immigrant sailed; now the cost ranges from $98 to $125 per person, but owing to the fall in foreign exchange, the immigrant has to pay an amount equivalent to $200 if he comes from Helsingfors or Copenhagen, and not less than ten times as much if he comes from Trieste. Moreover, he makes more 'money' at home than he did in 1913 and he has to pay more for railroad travel if he comes from inland, besides additional consular fees if he has to cross one or more frontiers in order to reach his port of embarkation. The literacy test, enacted in 1916, excludes many that would otherwise come. Mr. Frank Plachy, editor of the monthly magazine issued by the National City Bank, estimates that existing shipping facilities will not permit more than 750,000 immigrants to enter this country during the fiscal year ending in April 1921. During August the heavy immigration recorded in the three previous months showed a slump, to a net gain of 12,249, as compared with 21,373 in July. The net number of immigrant males arriving at the present time is at the rate of only 80,000 per annum.

CROPS are splendid, and they are being moved to market without undue financial dislocation. For this last we can thank the Federal Reserve system. The assurance of a large supply of grain in the country and in Canada has depressed prices naturally. Cotton is down because the textile trade, all over the world, is disorganized. The same applies to wool. Manufactured products have slumped in price. The era of fictitious values is nearing an end. Many are being hurt. It is not pleasant. Somebody must pay the piper and the tune sounds like a discord. That incorrigible ratio of supply and demand has a nasty way of asserting itself at inconvenient moments. Abundant harvests are as food to one man and poison to another. Falling prices bring tears here and smiles there. Even unemployment is not an unmixed evil if it makes organized labor pause in its [illegible] demands and realize that there must be an end to profiteering of service as of commodities. We need more homes for the people and cheaper food for those living on a narrow margin. It is time the country settled down from its orgy of price inflation. In any event, whether we like it or not, the time has come. There is suffering whenever economic changes come into effect violently, but come they must if human greed uses economic causes as an excuse for predatory business. Some day we shall establish some agency that will check profiteering as we now try, but not with much success, to check combinations in restraint of trade. In the civilization of a later day those who seize society by the throat in order to force excessive prices will be disciplined, without, let us hope, stifling legitimate competition.

OUR New York correspondent, on the page devoted to the Eastern Metal Market, has referred more than once to the fact that the lead market has been threatened with shipments of metal from Europe. German lead has been offered at 7 cents, duty paid. This prompts our contemporary, 'The Wallace Miner', to appeal for a tariff on lead in order to exclude the metal produced by the cheap labor of Europe. With this plea we sympathize, but we have reason to believe that our friend in the Coeur d'Alene is weeping over the wrong tombstone. It is not cheap labor, but cheap money—cheap as dirt—that is the cause of the trouble. The German who sells his lead for seven cents will convert the seven cents United States currency into four marks or more, this being 15 times the rate of exchange that obtained before the War. Thus the price of his lead is multiplied fifteen times, whereas the cost of the labor required to produce it has not been more than quadrupled. In plain English, the enhancement of the dollar has created a bridge for European exports and a corresponding barrier to imports from us. This is only one more of the annoying economic consequences of the present abnormal state of international affairs. Some of the dealings in foreign lead may be due to speculation in exchange and the reselling of metal previously sold to brokers on the other side. Last week we recorded the fact that the Consolidated Mining & Smelting Company of Canada presented a plea, to the Canadian Tariff Commission, for protection against imports and asked for an increase of the duty on pig-lead from one cent per pound to two cents. We may add that in 1913 the German production of lead was 181,100 tonnes (or metric tons), all of which and more was consumed at home, the total German consumption in that year being estimated at 246,000 tonnes. Just now the Germans must have need for all their lead and it is only the adverse credit position that excuses the exportation of it to us.

IN the 'El Paso Morning Times' we have read the report of a speech made by General Ignacio Enriquez, the Governor of the State of Chihuahua. He is a member of the class of 1910 in the University of Illinois and speaks English well, so that he is in a position to understand the American point of view. The Governor gave

utterance to many friendly sentiments: among others he said: "Our most ardent desire, as Mexicans, is to see that justice is accorded the foreigners who have aided so materially in the development of our country, but we are equally desirous of being treated fairly by other nations. With the idea of equity in mind, all the difficulties and misunderstandings could be easily solved." We hope they will be solved, even if the task be more difficult than it may seem on the occasion of an excellent luncheon at the University Club of El Paso. Certainly, goodwill and the desire to be fair will go a long way toward the desired consummation. On the same occasion General Alvaro Obregon, President-elect of Mexico, spoke briefly, and in Spanish, although we understand he also has an easy command of our language. He said: "We invite to Mexico such men as wish to work unselfishly for the well-being of all, both for themselves and the Mexicans, but we don't want men prompted by the speculative vice who seek only selfish self-profit". This is the translation by the interpreter present at the time and it may be faulty. Vulgarly speaking, it is 'guff', hardly worthy of a direct-acting soldierly leader. We fear that not many of our people can claim to be so altruistic and we shall forgive them if they are sceptical as to the actuation of their Mexican friends by motives so nearly angelic. Mining, we can say frankly, is usually actuated by "the speculative vice of selfish self-profit", and not by Sunday-school maxims or scientific idealism. We note 'The Financial Times', of London, sent a cablegram to General Obregon asking "the probable attitude of himself and his government toward foreign capital invested in the country". He replied personally as follows. "I have received your cable of the 8th September and can assure you that the new Government of Mexico will give preferential attention to its commitments abroad, will treat them with all seriousness, and will afford protection, in accordance with our laws, to all foreign capital invested in Mexico, or which may be so invested in the future."

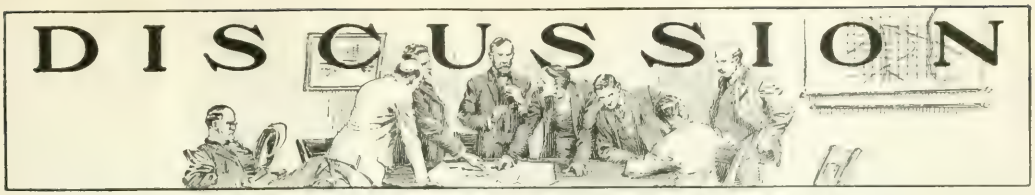
The Election

The election of the next President takes place in a few days. Of two things one can be certain, the first is that he will come from Ohio, and the second that his election will not be acclaimed with any great enthusiasm by the more thoughtful even of his own party. In truth, there has rarely been a presidential campaign so uninteresting and unsatisfactory. Thanks largely to our method of selection, by a mob in convention assembled, the two standard-bearers are men of no intellectual power. Their statesmanship appears to be on a par with their golf, and their political poise seems no better than their pose at the end of a drive. We have seen photographs of both gentlemen taken in the act: head up, weight on the wrong foot, club pointing skyward, and other sure evidence of a foozle. The betting is that the little white ball has been sliced into a bunker eighty yards on the right. Both owe their nomination to what are called political bosses, for the good reason that no assemblage of a thousand delegates can hope to make a selection except through a caucus of leaders. The attempt to split the parties on the issue of the League of Nations appears to have failed, for although Mr. Harding has no use for the existing League, he is being supported by Mr. Taft and Mr. Hoover, who were at one time uncompromising supporters of it, and by Senators Johnson and Borah, to whom it is anathema. The issue is President Wilson's administration, not the League; in short, it is a choice between the 'ins' and the 'outs'. As Mr. Hoover says, "the solemn referendum is not on the League, it is on the failure of the Democratic party". He and other progressive men prefer to support a reactionary Republican rather than run the risk of keeping the Democrats in power. As a matter of fact, the conduct of the War by the Democratic administration was distinctly more creditable than the performance of McKinley's administration during the Spanish war; that was marked by inefficiency and scandal of the grossest kinds, whereas the record of the Wilson regime during the recent war is comparatively free from the larger blemishes of stupidity and corruption. The country has no reason to be ashamed of its performance; it compares well with the records made by the European governments during the same critical period. The chief fault of it was that it was done with the apparent purpose of making it redound to the fame of one man and to the prestige of one party, instead of allowing the credit, like the effort, to be national. President Wilson played a poor game because he played a lone hand; he made the further blunder of estranging the best men in the Republican party by disregarding their desire for co-operation during the War and by ignoring their willingness to collaborate in the making of peace. When he delivered his message declaring war he should have called such men as ex-Presidents Roosevelt and Taft to his councils, possibly also Messrs. Root and Hughes, forming a coalition cabinet and thereby putting party considerations aside for the sake of the bigger and vastly more urgent duty that he had to perform as Chief Executive of the nation. He failed to rise to the occasion; he played small politics; he irritated his opponents; he flouted the Republican party; hence the bitter and unjust criticism, and even vilification, to which he has been subjected. History will do justice to his lofty idealism and to the other fine qualities of his statesmanship, but for the present he is the target of obloquy, much of which he has brought obtusely upon himself. He tried to claim all the renown and all the credit for himself and his party; to him and to his party therefore all the mischances and all the mistakes are being debited. The majority of the voters will agree with Mr. Hoover when he says: "It is fundamental when a party fails in statesmanship or fails to carry out its promises, it must accept the penalties of that failure; it should be retired in order that its leadership may be reformed". To this it may be replied that Governor Cox does represent a new leadership, but, unfortunately for him, he has to carry the incubus of the unpopularity of the President. Mr. Cox said to a heckler in Kansas:

"My friend, Wilson isn't running for President. Cox is running for President." It is true Governor Cox was nominated by the Democratic convention, but he is running on a platform that unreservedly endorsed President Wilson's administration. He must share its unpopularity. If the Democrats had nominated a man of real distinction, one who could command the confidence of the independent voters, they might have defeated Senator Harding. They failed to do so. Mr. Cox is cleverer than his rival; he can make a better speech, but he is too glib, he has promised too many things irresponsibly to be trusted in the high office to which he aspires. Indeed, the choice of candidates is lamentable. Moreover, there is no third-party leader for whom the independent voter can cast his ballot with any self-respect. That may be fortunate, for our theory of government is based upon a two-party system, and we have no desire whatever to see it degenerate into the welter of confusion that characterizes the conflict of three or more political groups in the legislatures of Europe. At the close of the campaign the issue has narrowed down to a party basis; the larger questions are in the discard; even the Republicans who wanted to overthrow the unrepresentative system that caused the nomination of Senator Harding are willing to postpone an attack upon that system until their party is safely in power; even the Democrats who know Governor Cox's wretched war record will vote for him in order to endorse the Wilson administration. On that they will go to defeat. For ourselves, we ought to be pleased to see Mr. Harding elected because he and his friends undoubtedly will look after the welfare of the business interests, including those of publishers, but, looking at the Presidential election in a worthier way, we regret that he could not be opposed, and defeated, by a man of keener intelligence, of robuster character, and of more liberal ideas.

A New Mineral

Queer things are found in nature, particularly where chemical and physical forces have operated with abnormal intensity, as in Nevada. From that great mineral region there comes the news that an enterprise has been launched of which it may be said, in the words of a South Sea Bubble prospectus, that it is "a project the nature of which will be later divulged". However, we would deem it unkind to withhold even our present incomplete information from a world eager for enlightenment. We are told that a discovery has been made more important in a truly economic sense than that which made the Busted mountains famous in the early days, or the celebrated Hallelujah Consolidated, whose search for oil in the obsidian of the Never-Never land has excited keen interest among geologists. The enterprise to which we refer is already the subject of excited conversation in every mining community in Nevada; it is called the Wet Products Corporation and its promoters are said to control 25 claims covering an immense deposit of 'hootchite', or 'hootchspar', a mineral containing a large percentage of alcohol. The deposit is covered by a flow of lava, a variety of dolerite, but its existence was disclosed by a natural spring. It appears that Blinkey McGuire, the well-known prospector, happened to see a coyote in hot pursuit of a rabbit, which stopped and took a drink at the spring. The chase was resumed, but, much to McGuire's astonishment, the rabbit turned on the coyote and attacked it savagely, compelling it to retreat. The rabbit jumped, tumbled, and rolled, as if in an ecstacy, and then started after the coyote with such speed that its tail was extended horizontally. McGuire, being of a scientific turn of mind, was curious. He examined the spring, and, being an experienced prospector, he had no difficulty in detecting the familiar odor of a venerable corn whiskey. He took a sample with him for analysis at Goldfield, where his surmise was confirmed. Returning to the spot with several mining engineers, who were willing to assist him in a scientific study of the deposit, it was ascertained that in an earlier geologic period the valley and the surrounding hills had been covered with vast corn-fields, probably in the Carboniferous period, when vegetal growth was so abundant. A flood had swept the corn into the central part of the valley and a flow of lava had buried it completely, as in a retort. Heat and pressure, during long geologic time, had consolidated the decaying corn into a soft yellowish mineral, now known at 'hootchite , or 'hootchspar', which at one place, where the lava is fractured, has been dissolved by the ground-water and brought to the surface as a medicated spring. This opening has been cemented already in order to prevent further wastage. The deposit itself, judging from the local stratigraphy, lies at a depth of about 2739 feet, and a drill-hole is to be sunk to it, with suitable preparation for closing it with a valve so as to regulate the flow of precious liquid. Whether it will be advisable to sink a shaft in order to mine the solid hootchite or whether the deposit can be extracted by leaching it, as is done in salt mines, or by admitting live steam and melting it, as is done in the exploitation of sulphur, for example, is not yet decided. We are informed that a market is assured at $25 per quart of solution or $250 per pound of 65% hootchite. Preferred stock has been placed on the market, the immediate consequence being a big drop in the quotations for Liberty bonds at Goldfield, Tonopah, and Virginia City. Government officials are on the ground already and the U. S. Bureau of Mines has sent a mine-rescue team to the locality, with oxygen helmets, in case the fume of the hootchite should overcome the force of men now engaged in preliminary operations. Undoubtedly this will prove an important addition to the mineral resources of Nevada; it may prove as important as the layer of soapstone discovered a few years ago near Lovelock; it was a kind of ozokerite and proved so useful in removing the stains on the escutcheon of the State that the State Treasurer, on the suggestion of George Graham Rice, changed the motto of the commonwealth to 'While there is life there is soap'. Since then wash-sales of mining stock on Bush street have been conducted with a success that has aroused the admiration of the State Commissioner of Corporations.



The Geology of Brazil

The Editor:

Sir—In the bulletin of the Geological Society of America of June 30, 1919, there was published a paper entitled 'Outlines of the Geology of Brazil to Accompany the Geological Map of Brazil', by John Casper Branner.

The appearance of this map and sketch is a notable event worthy of more notice than it has received and its title would connote, for it not only possesses great merit as a contribution to geologic literature, but is also of the utmost practical value to the mining engineer interested and engaged in the economic development of this enormous country. In a sense it may be regarded as the culmination of the life work of one of our most distinguished, careful, and competent geologists, a sort of *magnum opus* the result of years of hard work and study for the mere love of it. It is true Branner was in the service of the Brazilian government in various capacities for a number of years, although he appears to have been insufficiently sustained by the authorities. But to him, with the possible exception of Orville Derby, we owe more than to anyone else the only clear and comprehensive conception it is possible to obtain of the general geologic character of Brazil.

Save in a few localities, Branner's work makes no pretense of detailed accuracy, indeed it could not be otherwise of so enormous a country not yet wholly explored even in a geographic sense. Some of the States, such as Minas Geraes and Bahia, are comparatively well known and mapped with some degree of accuracy and it is to such localities more than elsewhere I would like in a few words to direct attention.

When the Portuguese made their first settlements in Brazil, gold mining, or rather gold-washing, became one of the occupations to which they devoted much attention and from which they derived considerable wealth. As a consequence the operations were large and the hinterland back of Rio de Janeiro settled rather rapidly considering those primitive times, the name Minas Geraes resulted from this circumstance. The discovery of diamonds followed later (about 1725) and Brazil became, for those days, the second great diamond-producing country, India being first.

In some respects Brazil reminds me of China as I first knew that interesting country in the year 1900, and Branner bears much the same relation to Brazil as Richthofen does to China in making known to an ignorant and then little interested world the mineral resources of the three or four great untapped reservoirs of raw material now so badly needed in this industrial-plagued planet.

In Brazil, however, unlike China, two of the most important factors of our so-called modern civilization are conspicuous by their absence, namely, coal and petroleum. Of the first there is a modicum to be found in the Permian rocks of Rio Grande do Sul. Very high in ash and of low calorific power, these coals must be washed and treated to be successfully made into coke. The Carboniferous formation is by no means wanting among the rocks of this vast country, but so far no coal-bearing measures belonging to them have been discovered nor does it seem likely there ever will be.

Of petroleum there are few indications, but when one considers the vast size of the country and how imperfectly many parts have been explored in a geographic sense, not to say prospected in a mineral way, it is obviously unwise to have any opinion regarding the matter. Curiously enough, however, petroleum's first cousin, oil-shale, is abundant along the cost of Brazil, being found in the Eocene-Tertiary rocks that extend from the Amazon on the north along the coast south nearly to Rio de Janeiro, a distance of almost two thousand miles, with but few breaks or intervals in their continuity. Almost anywhere in this Tertiary area, oil-bearing shales might be expected, but so far they have been located and definitely identified in but a few localities, probably for the simple reason that no systematic search has been made for them. In thickness these beds of shale vary from six to twelve feet and yield as much as forty gallons of oil per ton of rock.

The lack of fuel in Brazil is almost tragic in its seriousness. Here we have one of the largest countries of the world with a stable government, vast natural resources of many different kinds and iron-ore deposits unsurpassed, if indeed equalled as to quality and quantity, wholly dependent upon foreign sources of supply for coal and coke, which inland is practically at a prohibitive price. Such conditions preclude the establishment of iron and steel industries, which must necessarily be the basis of modern industrial progress and logically the result of such enormous local supplies of raw material other than fuel. What may be expected of electric smelting in this connection is conjectural, of course, as the state of the art is hardly sufficiently advanced to form any definite conclusion; such is certainly the case with iron, however satisfactory the results may be in smelting other metals. Brazil affords many opportunities for the installation of hydro-electric power plants, some of great size and in fairly convenient localities. Doubtless the

solution of her difficulties in establishing a large metallurgical industry is to be found in this direction.

One is impressed in studying Branner's map by the immense area of Archean rocks that constitute the eastern part of Brazil. They are practically continuous north and south from about latitude 2° S. to 32° S. and in places the belt is hundreds of miles wide from the coast westward. These old rocks, especially when associated with the early Paleozoic and Silurian formations, are likely to be important depositories of metallic minerals. Thus, for example, in Minas Geraes we find rich iron ores as well as manganese ores affiliated with early Paleozoic sediments. The best and largest manganese deposits appear, however, to favor the crystalline schists and limestones of the Archean, and, naturally, one would look for the chrome deposits in the serpentine and gneiss of this comprehensive and welcoming group of rocks to which is relegated everything in the way of formations too old for positive identification. The famous Morro Velho gold mine, belonging to the St. John del Rey company, is in the Archean, the lodes consisting of lenticular shoots of quartz intercalated in the country-rock. The quartz contains, in addition to gold, varying amounts of pyrite and pyrrhotite, together with carbonates of lime, magnesia, and iron. The most extraordinary thing about this mine is the persistence of the precious mineralization, it having now been proved, with relatively slight change, to a depth of considerably over six thousand feet, this being the deepest gold mining in the world. It is a notable fact that not one of the other gold mines of Brazil has approached the Morro Velho in magnitude and importance; undoubtedly the operation of the property has been skilfully and determinedly conducted, which may account for its predominance, for of all classes of metal mining that of gold demands the highest degree of skill and pertinacity.

A noted peculiarity of the Archaen granites of Brazil is the presence in many of them of a rare group of minerals containing cerium, lanthanum, zirconium, and thorium, the last being the oxide from which incandescent gaslight mantles are made.

In considering general mining conditions in South America, the mind naturally turns to those countries whose mines have achieved historic distinction, if not fame. The world has long since heard of the gold of Antioquia (Colombia), the probable source of most of the gold of the Incas, the silver of Potosi (Bolivia), and the copper of Chile, to say nothing of the emeralds of Muzo (on the Bogota plateau, Colombia) and the tin of Bolivia. But except for diamonds, an almost insignificant industry as compared with that in South Africa, very little is heard of the mines of Brazil, despite that today this country contains the greatest reserves of iron ore known to an extravagant and wasteful civilization. As a producer of minerals Brazil is today a negligible factor, for even its manganese, the only ore exported in quantity, is not indispensable, for it is no better than the Indian and not so good as the Caucasian.

The publication of this splendid geologic map of Branner's is therefore most opportune, giving as it does to the mining engineer a welcome insight into the possibilities of this vast unexploited and undeveloped territory, a country full of promise in meeting the demands of an expectant industrial world, a Europe almost drained of its mineral wealth, and a North America doing its best to follow suit. On the whole, the mineral resources of Brazil assure an enduring character. As we know, the iron deposits are unsurpassed; of copper, there are indications of much; and of manganese, chrome, and gold there are positive proofs that extended explorations and prospecting will result in the discovery of many new deposits of a commercial character.

If the technical and practical difficulties in the economic treatment of oil-shale can be overcome successfully, as no doubt they will be, a domestic fuel-supply is assured, not to mention the by-products as an indirect source of wealth and an aid to agricultural industry by reason of the production of ammonium sulphate. An independent supply of fuel, gasoline, lubricants, and fertilizers would thus be obtained as the result of the development of one heretofore wholly neglected mineral product whose value has until now been almost wholly unsuspected, or at any rate never regarded of sufficient importance to demand Government aid in its exploitation.

The unselfish and devoted work of Branner in Brazil is sure to be progressively appreciated as the years go on and the virgin areas he so conscientiously sketched and mapped, crude and rough though much of the work must necessarily be, respond to the touch of development and detailed study under the direction of the economic geologist and mining engineer. He has laid the foundations in this geological map, something substantial to build on, a thing no other South American country possesses, except possibly British Guiana, where an enlightened progressive government and J. B. Harrison, a geologist of the Branner stamp, have given us an excellent series of reports and maps of a country, although very much smaller, yet quite as difficult to explore as the Amazonas of Brazil. All honor to such men as these two, veritable pioneers of science, blazing the way and making smoother the path of those who follow after. Honor and satisfaction for difficult work well done is probably all the reward they can expect, and it is pretty certain it is all they will get from a world that has ever thus recompensed its greatest benefactors.

F. Lynwood Garrison.

Philadelphia, September 21.

The United States is still dependent on foreign countries for its supply of platinum. The total quantity of refined platinum and allied metals recovered from foreign and domestic ores by domestic refiners decreased from 59,753 oz. in 1918 to 45,109 oz. in 1919. Only 11,759 oz. of refined platinum was derived from domestic ores in 1919. On the other hand, the imports of platinum and allied metals increased from 56,753 oz. in 1918 to 68,054 oz. in 1919, nearly half of which came from Colombia.

Geology of the El Tigre District, Mexico

By R. T. MISHLER

Geography. To furnish a framework upon which to hang the geology, a brief outline of the geography of the surrounding country is necessary. The Tigre (or 'Lucky Tiger') mine is situated in the north-eastern part of Sonora, Mexico. The elevation is 5800 ft. Four miles north of El Tigre is Pilares de Teras, where are the Cinco de Mayo and Roy mines. Two miles north of El Tigre are the North Tigre and Santa Maria mines.

The district lies on the steep western slope of the Teras range of mountains. It is traversed by several deep canyons, all flowing west. The Bota is the deepest; it is three miles north of El Tigre and separates the Pilares and North Tigre districts. A branch of the Bota canyon has its source behind Tigre peak, the high mountain a mile east of the town.

At the north edge of the town is the Combination canyon; at the south edge is Espuelas canyon. The two join at the mill to form the head-waters of the Chinosos stream. A mile south of the town is the Tigre canyon. This is a branch of the Otates *arroyo*, which drains the west flank of the Teras range as far south as the Temblor mine. On the east side of the range the Pita canyon is the largest and deepest. The Pita stream flows east and empties into the Bavispe river near the town of San Miguel. Here the Bavispe flows north, between the Teras and Sierra Nevada ranges. Thirty miles north of El Tigre the river makes a loop around the north end of the Teras range and flows south, receiving the waters of the Bota, Chinosos, and Otates streams, before joining the Aros to form the Yaqui river.

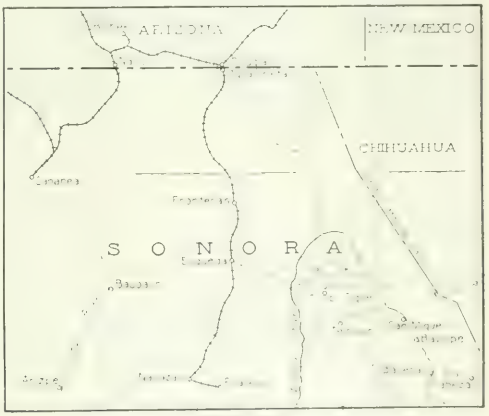
A rectangular area, including the principal claims of the Tigre Mining Company, was selected for detailed geological work. This area is roughly two miles long (north to south) by one mile wide. It extends from Palomitas canyon on the north to the South Tigre workings on the south; and from the mill on the west to the charcoal kilns on the east.

General Geology. During Mesozoic time the region about El Tigre was a rolling plain, covered with fluviatile fans fed by the erosion of the granite and limestone. Probably this surface was fairly close to sea-level, for only 20 miles west are thick beds of calcareous shale, which appear to have been deposited during the Mesozoic era.

Portions of the old surface are found at several places. The most conspicuous of these is the level bench above the dark rock on the hill north of the mill. The mill itself is on the granite, at a considerable distance below the Mesozoic surface; the old surface as well as all overlying strata having been trenched during recent time by the Chinosos stream. It is interesting to note that stratigraphically the mill is at the lowest point for miles roundabout.

The Tertiary era was an age of intense volcanic activity. The old surface was covered with successive flows of rhyolite and rhyolite tuff; the whole series aggregating 4000 ft. in thickness. This volcanic rock constitutes the main part of the mountains about El Tigre.

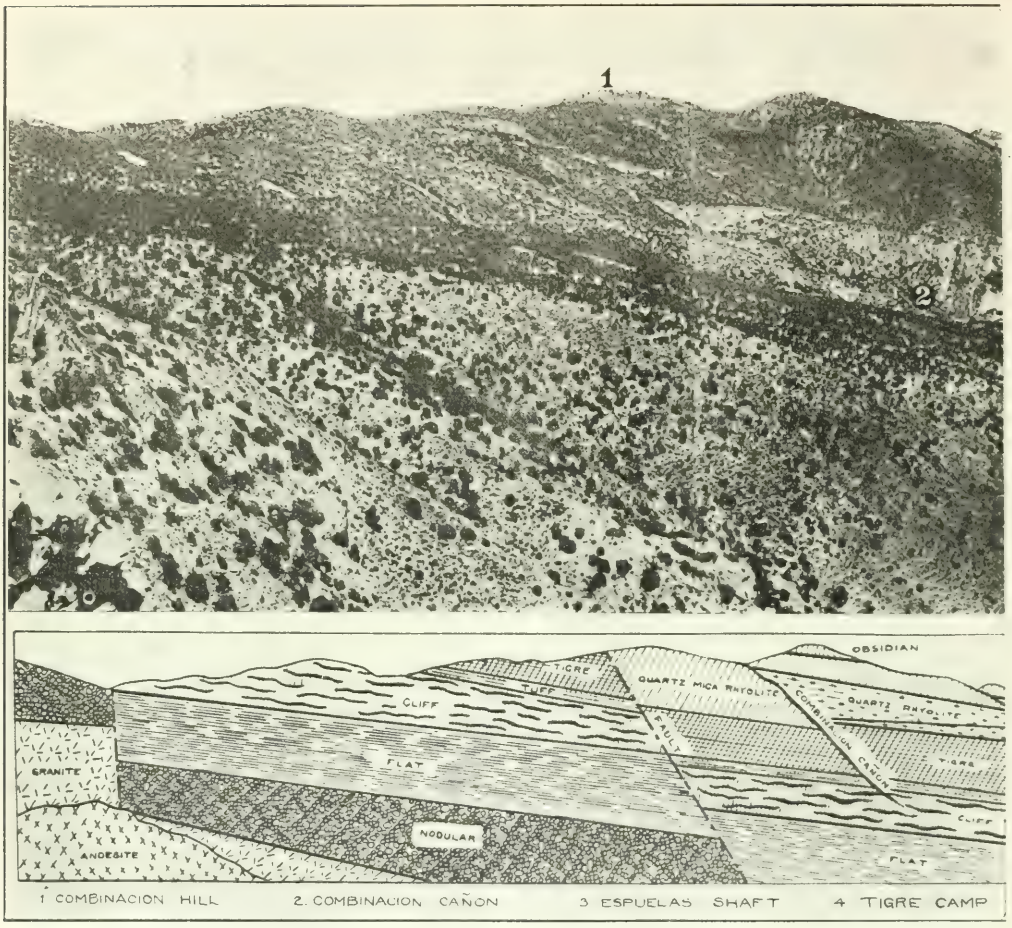
The lowest flow of lava, called locally the 'Nodular' formation, was laid down early in Tertiary time. After its formation, volcanic activities ceased for a while. Minor drainage systems were formed and an extensive lake was developed, with its centre where the town is now. The bed of the lake became filled with shale and thin layers of limestone. Later a new volcanic era was



MAP OF PART OF MEXICO

ushered in by showers of volcanic 'ash'. These formed beds of tuff, blotting out the inequalities caused by former erosion and covering the old lake-bed to a depth of 500 ft. Finally, a single flow of lava, 250 ft. thick, was poured out upon the tuff and overspread the whole district. The tuff and calcareous shale have received the local name of 'Flat' formation. The massive lava-flow is called the 'Cliff' formation. It constitutes the escarpment just above the town.

Following the deposition of the Cliff lava, there was another lull in volcanic activity, during which 50 ft. of wind-stratified tuff was laid down. Then followed the most intense period of volcanic activity. Flow followed flow, until a mass of lava 2500 ft. thick had been piled upon the tuff beds. The various flows have been differentiated according to their physical characteristics and, from bottom to top, have received the names of 'Tigre', 'Upper Tigre', 'Quartz-Rhyolite', 'Quartz-Mica Rhyolite', and 'Glassy Rhyolite'. The last constitutes the last



GEOLOGICAL SECTION OF

of the volcanic series and is found only on the mountain-tops.

Near the close of the volcanic era, the district was raised to approximately its present elevation, the sedimentary strata and lower volcanic flows being tilted to the south at an angle of 15°. The tilting, and possibly the uplift, were completed before the end of the volcanic period, for the upper flows are all thickest toward the south, thus equalizing the effect of the dip in the lower strata. At the close of the volcanic era, the region was probably fairly flat, with the surface at the height of the present mountain-peaks.

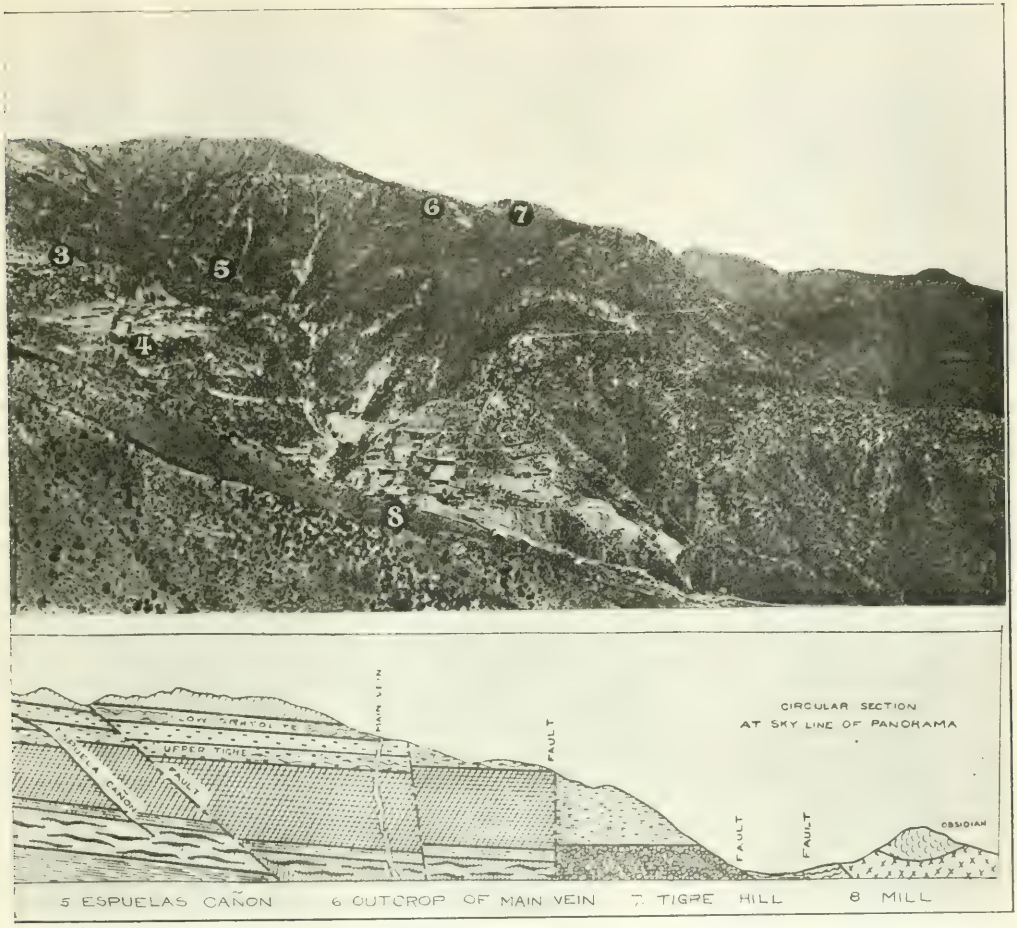
During the period of uplift the region about El Tigre was subjected to minor fracturing and faulting. Through the faults and fractures welled up metal-bearing solutions, which altered the rock of the lower members of the volcanic series and formed veins.

During and after the deposition of ore, the country was dislocated by extensive north-south faults and minor east-west faults. Andesite rose through the faults, forming dikes and stocks, and overflowing in places to form minor flows.

The general blocking out of the mountain ranges was effected by the north-south faults. Erosion followed and carved the mountains to their present shape.

Descriptive Geology. The oldest sedimentary rock exposed in the district is limestone. From similarity in character and position to the Carboniferous limestone of Arizona, it has been classified as belonging to that period. It is fairly pure, of grayish blue color, and occurs in thick beds with a general dip of 30° west. Outcrops of limestone are found in the beds of Pita and Bota canyons, at Pilares de Teras and at the lime-kilns a mile west of El Tigre. Although the limestone does not outcrop within the Tigre quadrangle, its occurrence on three sides leads to the supposition that it underlies at least a part of the quadrangle.

Outcropping at the same general horizon as the lime-



THE EL TIGRE DISTRICT, IN SONORA, MEXICO

stone is an intrusion of granite consisting mainly of microline, sanidine, quartz, and phogophite mica, the last now largely changed to serpentine and iron oxide. It is probably late Paleozoic. The granite is exposed in the canyons near the Tigre mill and also in Palomitas and Pita canyons. It probably underlies the greater part of the Tigre quadrangle.

The Nodular formation is the lowest member of the volcanic series. It was originally a glassy lava containing aggregates of spherules. The groundmass is now much kaolinized. The spherules are remarkably well developed, occasionally reaching a diameter of 18 inches. In places they are crowded so close together as to give the rock the appearance of a conglomerate. They are usually separated from the kaolinized groundmass by films of limonite or gypsum. Unaltered specimens contain 75% silica. The rock is classed as rhyolite.

Overlying the Nodular formation is a bed of rhyolite-tuff and calcareous shale; locallly this is termed the Flat formation. It is 500 ft. thick at El Tigre, but diminishes in thickness in all directions from the mining camp. The tuff is well stratified, indicating that it was deposited under water. The binding material is secondary calcite and quartz, the latter predominating. In many places the deposition of secondary silica has been so intense as to obscure the tufaceous character of the original rock, only slight tabular parting remaining along the original bedding-planes. Silicification is especially noticeable in the bottom of the formation and along old fissures and veins. Unchanged specimens of the tuff contain 71% silica, indicating that it should be classed as rhyolite.

The Cliff formation consists of a massive flow of fine-grained rhyolite, 250 ft. thick. It shows small phenocrysts of sanidine and quartz in a felsitic groundmass. The most important mine-workings are now in this formation. Near the vein-systems the formation is criss-crossed by minute quartz veinlets. The silicified rock is the hardest in the region and is being used with success

in the tube-mills. The Cliff formation contains 80% silica and is classed as rhyolite.

Overlying the Cliff formation are beds of rhyolite-tuff, aggregating 60 ft. in thickness. It is always greatly altered, is the softest rock in the region, and is characterized by containing large cubes of secondary pyrite. Some of the best orebodiees have occurred in this formation. The tuff contains 71% silica, indicating that it should be classed as rhyolite.

The Tigre formation is a flow of rhyolite, 400 ft. thick, in which occurred the principal orebodies of the upper part of the mine. It is a medium-hard porphyritic rock with abundant crystals of sanidine and quartz in a felsitic groundmass. Pyrite, in small cubes, is abundant, especially near the veins. The Tigre formation contains 72% silica and is classed as rhyolite.

Overlying the Tigre formation are the Upper Tigre formation, quartz-rhyolite, quartz-mica rhyolite, and glassy rhyolite. All are porphyritic, containing crystals of sanidine, quartz, and mica in a glassy groundmass. The silica content ranges from 68% in the Upper Tigre formation to 81% in the quartz-rhyolite. No ore of commercial importance has been found in any of these flows.

Cutting through all the rocks of the region are a number of andesite stocks and dikes. One dike was intruded along the Sooy vein after ore deposition was complete. The North Tigre deposit occurs in a sill of this andesite. The wide distribution of andesite dikes along the whole Teras range and the occurrence of large bodies of andesite in the deeper canyons indicate that the andesite constitutes the core of the range. It seems possible likewise that the intrusion caused the faulting and general blocking out of the range, and may have been responsible for the ore deposition. The rock consists of minute laths of labradorite, interspersed with grains of augite. It contains 52% silica and is classed as augite-andesite.

Faults are numerous and in places produce dislocations of several hundred feet. All those observed are normal, that is, when the fault-plane is inclined, the upper side (or hanging wall) has slipped downward. All the major faults traverse the country in a general northwest-southeast direction, parallel to the axis of the range. Minor displacements cross the district in various directions.

The veins themselves are minor faults and represent the first fracturing in the region. While ore deposition was in progress, the south end of the main vein was intersected by a series of faults parallel to the vein, but dipping at a steeper angle westward. The total throw aggregates 200 ft. The best ore has been found near these faults. During the same period the north half of the vein was dislocated by three east-west faults, each with a throw of 50 ft. south. The principal deposits in the north half of the mine have occurred near these faults. In general the ore occurs in fractures and faults dipping west and is associated with fractures and faults dipping west and south. Faults dipping east or north were later than ore deposition and have no relation to it.

By far the greatest dislocations of the region have occurred during comparatively recent time. Two great fault-systems traverse the country in a northwest-southeast direction. The larger cuts diagonally across the south-west corner of the quadrangle, extending for miles along the foot of the high mountains. The entire western flank of the range has slid downward along this fault, the displacement ranging from 1500 to 3000 ft. This fault has been re-opened twice since 1880, both these re-openings being accompanied by severe earthquakes. The second largest fault traverses the centre of the quadrangle, passing between the mine and the mill. The east side has been dropped 500 ft. The two great faults have depressed both the central ridge and the western flank of the mountain range, leaving an intermediate zone stratigraphically higher than the formations on either side. The resulting inequality of the surface has been pared off by erosion till the zone is lower than the depressed areas. This explains why the oldest rocks of the region are found in the eroded area surrounding the mill, whereas the districts both east and west are composed of more recent lava-flows.

Three late faults cut the main vein. They all dip north. The throw is also to the north and ranges from 150 ft. for the two northernmost to 400 ft. for the most southerly. All three have dislocated the vein and have caused some confusion in the development of the mine. All are normal, and the recognition of this fact has aided materially in the solution of the fault problems.

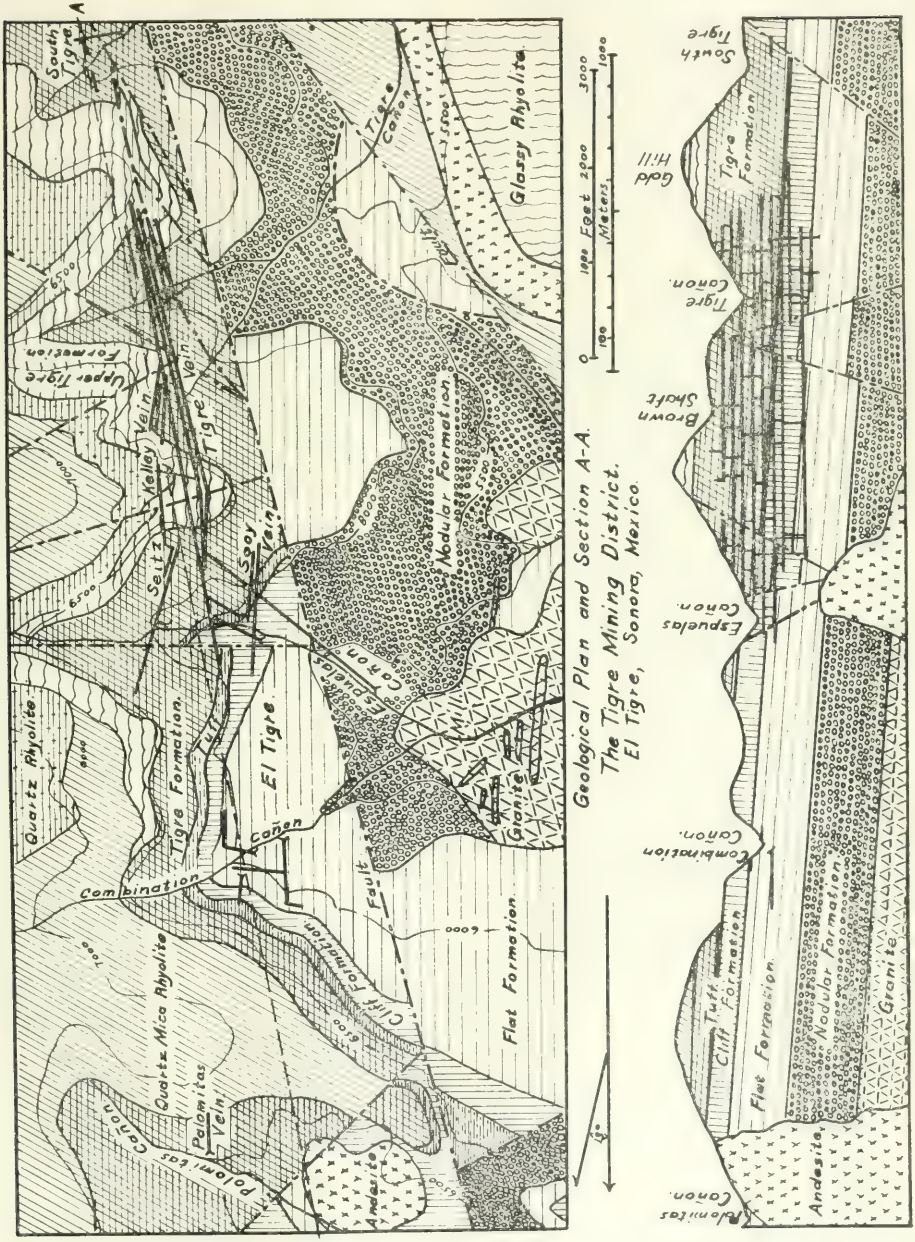
A simple rule for locating the continuation of faulted veins has been found to apply to normal faults: "If the fault dips from you as you face the end of the drift, cross-cut into the foot-wall of the vein; otherwise cross-cut into the hanging wall." The two words "from" and "foot-wall", beginning with 'f', aid in remembering the rule. The rule is not applicable to reverse faults and may not be applicable where there has been a side movement along the fault, or where the vein is nearly vertical and strikes nearly parallel to the fault; but it probably applies to 80% or more of the fault problems encountered in mining. It is suggested as a convenient rule of thumb for the practical miner.

Economic Geology. The Tigre mine is essentially a silver-gold property. Silver constitutes 85% of the value and gold 11%. Copper and lead are of secondary importance, each contributing about 2% of the total value.

Since the beginning of operations in 1903, the total ore extracted from the mine has amounted to 700,000 tons, assaying gold 0.25 oz.; silver, 39 oz.; copper, 0.25%; lead, 1%; and zinc, 1.5%. The various shipments to the smelters have aggregated 15,000 tons of shipping ore, 34,000 tons of concentrate, and 290 tons of bullion. The shipping ore and concentrate have averaged 2.7 oz. gold and 390 oz. silver per ton. The bullion has averaged 700 fine in silver and gold.

There are four important veins on the property of the Tigre Mining Company. Named from west to east, they are: the Sooy vein, the Tigre or main vein, the Palomitas-Protectora, and the Seitz-Kelley vein.

All the veins have been deposited along fissures. The filling is composed of kaolinized or party silicified country-rock, usually with deposition of quartz along the


Geological Plan and Section A-A.
The Tigre Mining District.
El Tigre, Sonora, Mexico.
Meters
Feet
Quartz Rhyolite
Tigre Formation
El Tigre
Cañon
Combination
Fault
Cliff Formation
Flat Formation
Granite
Glassy Rhyolite
Nodular Formation
Espuelas Cañon
Upper Tigre Formation
Seitz Valley Vein
Tigre Vein
Soyo Vein
Quartz Mica Rhyolite
Palomitas Vein
Palomitas Cañon
Andesite
South Tigre
Gold Hill
Brown Shaft
Tigre Cañon
Tuff Formation

fissure-planes and in the interstices between the fragments of country-rock. The ore consists of mixed sulphides of zinc, iron, lead, copper, and silver, with their decomposition products. Gold is associated with the copper. The ore occurs in discontinuous lenses of high-grade sulphides, and as low-grade impregnations in the vein-matter. The wall-rock is rhyolite and rhyolite-tuff; it is silicified at points where the veins are highly silicious, and kaolinized where silica is scant or lacking in the veins.

All the veins strike nearly north-south. The Tigre or main vein strikes N. 10° W. The Sooy, Palomitas-Protectora, and the Seitz-Kelley veins are parallel to each other, striking N. 5° E. The dip of all the veins is to the west, averaging 60°.

The Tigre, Sooy, and Seitz-Kelley veins are the only ones in the district that have been worked at a considerable profit. The Tigre has been the most productive, having yielded 90% of the ore so far produced. It extends from a point 300 ft. east of camp to the south slope of Gold Hill, a distance of a mile and a half.

The croppings are insignificant. Sulphide ore appears at one spot only, namely, in the south fork of Espuelas canyon, near the entrance to No. 2 level. Here the outcrop is 200 ft. long and six inches wide. A half-mile south, near the Brown shaft, a rich pocket of gold ore was found at surface. Again on Gold Hill, south of Tigre canyon, low-grade ore outcrops for a distace of 100 ft. Aside from these three insignificant showings, the croppings are scant and practically barren.

The development on the Tigre vein consists of ten levels, driven at 100-ft. intervals. Six only of these are adits.

The ore-channel so far developed on the Tigre vein is a mile long by approximately 700 ft. along the dip. It extends from Espuelas canyon on the north to the centre of Gold Hill on the south. The upper limit of the orebody coincides with Level A. The bottom limit roughly follows the contact between the Cliff and Flat formations, dipping south in conformity with the volcanic beds. Thus at the north end of the mine, the ore terminates on Level 5, while at the south end good ore continues below Level 8. Within the limits outlined two-thirds of the vein has been ore.

The average width of the vein is three feet. In places it narrows to a mere cleft, elsewhere it widens to 10 or 20 feet.

The Sooy vein outcrops strongly in the Espuelas canyon, just south of camp, the sulphide ore coming to surface. It was at this outcrop that the first discovery was made. The vein is worked in conjunction with the Tigre. The orebody has the shape of an inverted equilateral triangle, 500 ft. on a side. The apex of the triangle rests on Level 8, the base on Level 3½. The ore occurs between the walls of the Tuff, Cliff, and Flat formations. The vein is much shattered, showing evidence of movement subsequent to ore deposition. The shattered condition has permitted surface-waters to come in contact with the sulphides, decomposing them. Much of the ore in the upper levels consists of oxides and carbonates.

Irregular dikes of andesite have intruded into the Sooy vein since its deposition.

The Seitz and Kelley deposits are on the same vein system. The Kelley deposit joins the Main vein just north of Tigre canyon. The junction of the two is poor. The Kelley deposit is disc shaped, 500 ft. in diameter and three feet in average width. The deposits on the Seitz vein are 1000 ft. north of the Kelley deposit. They consist of small lenses, separated by extensive areas of barren vein-matter. The largest lens lies in the north end of the mine at the horizon of No. 2 level. It is elliptical, 600 by 100 ft., the longer axis being horizontal. The vein seldom exceeds six inches in width.

The Palomitas-Protectora vein extends from Combination hill to within a mile of the Bota canyon. From its position, dip, and strike it can be considered as the north extension of the Sooy vein. The deposit exposed in the Palomitas mine is roughly 150 by 50 by 3½ ft., and consists of oxidized ore assaying 0.11 oz. gold and 50 oz. silver per ton. The Protectora (North Tigre) deposit, as developed to date, is 1000 ft. long by 350 ft. deep by 2 ft. in average width. The ore consists of sulphides of zinc, lead, iron, and copper in a gangue of quartz and decomposed country-rock. The silver is associated with gray copper and chalcopyrite. Galena and sphalerite are the predominating sulphides. They assay much lower than at Tigre.

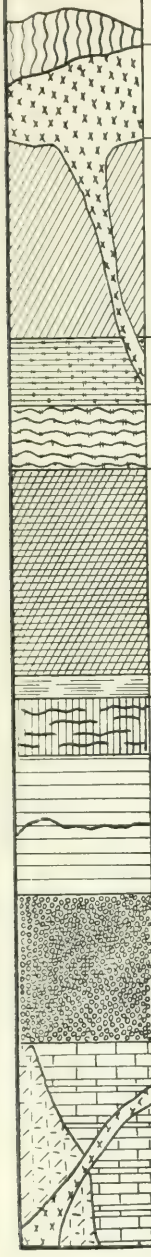
Relation of Ore Deposits to Stratification. Ore has been found at El Tigre only in the Tigre, Tuff, Cliff, and Flat formations. The deposit at North Tigre occurs in the Flat formation and in andesite. The character of the wall-rock has affected the shape of the ore deposits. In the Tigre formation, the veins are of fairly uniform width, varying from one to five feet, and increasing to greater width only near the intersections with cross-veins. The deposits are continuous for long distances. Branch veins, with the exception of the Kelley vein, are short in extent.

In the Tuff formation the vein is extremely variable in width. In most places it consists only of a talc seam with no ore. At cross-fractures or branch veins the width is sometimes 20 ft. In all cases the deposits are irregular and difficult to follow.

In the Cliff formation the brittle character of the rock has been especially favorable for fracturing. The ore characteristically occurs in two or more veins. Usually both the veins and the walls are hard and firm.

Ore has been found in the Flat formation only in the Sooy vein. Here the deposit was lenticular, 200 ft. in diameter and 20 ft. in maximum thickness. The ore consisted of sulphides of copper, zinc, and lead, in a quartz gangue. The silver was associated with the copper minerals (as is the case at North Tigre) and not with the zinc and lead, as in other Tigre deposits. It is possible that the lower Sooy orebody was deposited at the same time as the North Tigre ore.

There appears to be little relation between wall-rock and the character of the ore. This is especially true as regards the silver and lead minerals. There is perhaps a slightly increased proportion of chalcopyrite and gold



OBSIDIAN.	ACID GLASS, MOST RECENT FLOW IN THE DISTRICT.
ANDESITE	AUGITE ANDESITE, CUTTING ALL OF THE UNDERLYING FORMATIONS
QUARTZ MICA RHYOLITE 400'-700'	HOMOGENIOUS MASS, SHOWING ABUNDANT PHENOCRYSTS OF QUARTZ AND BIOTITE.
QUARTZ RHYOLITE 150'-300'.	DEVITRIFIED RHYOLITE, MICROCRYSTALLINE GROUND MASS, PROMINENT PHENOCRYSTS OF QUARTZ.
UPPER TIGRE FORMATION. 200'-300'.	SODIC RHYOLITE, CHARACTERIZED BY TABULAR WEATHERING AND A TENDENCY TO FORM CLIFFS.
TIGRE FORMATION 350'-700'.	DEVITRIFIED RHYOLITE, CHARACTERIZED BY ABUNDANCE OF ALKALINE FELDSPARS.
TUFF 60'-100'	RHYOLITE TUFF.
CLIFF FORMATION 250'	FINE GRAINED RHYOLITE, CHARACTERIZED BY TENDENCY TO FORM BOLD CLIFFS.
FLAT FORMATION 200'-300'.	RHYOLITE TUFF WITH OCCASIONAL BEDS OF LIMESTONE AND ARGILLACEOUS SEDIMENTS DISTINCTLY STRATIFIED.
SILICIFIED FLAT FORMATION. 200'-300'	SHOWS INTENSE SILICIFICATION AND TABULAR PARTING PARALLEL TO FORMER BEDDING PLANES.
NODULAR FORMATION, 500'-700'.	FORMERLY GLASSY RHYOLITE, CHARACTERIZED BY AGGREGATES OF SPHERULES.
GRANITE AND LIMESTONE CUT BY ANDESITE DYKES.	COARSE GRAINED MICA GRANITE. COMPARATIVELY PURE LIMESTONE OCCURRING IN THICK BEDS.

COLUMNAR SECTION OF LOCAL GEOLOGY

in the Cliff and Flat formations. Zinc-blende also is more noticeable in the bottom of the mine, but this may be due to its susceptibility to the agencies of secondary enrichment.

Genesis of Ore Deposits. There are two possible explanations of the genesis of the ore deposits.

The first is that the ore deposition was associated with deep-seated granitic intrusions from which the rhyolite flows were derived. Such intrusions have been clearly recognized in the Chitahueca mountain 25 miles to the east. It is possible also that the granite of Pita canyon was of this age, for it is much fresher than the Pre-Tertiary granite at the Tigre mill. The possibility of an extensive intrusion of Tertiary granite beneath El Tigre is indicated by the tilting of the lower volcanics before the extrusion of rhyolite was complete. The tilting of the volcanics could have caused the minor fracturing and faulting associated with the vein formation. The vein-filling could have been dissolved from the cooling intrusion and contiguous rocks. The granitic intrusion unquestionably contained silver, for the rhyolites, derived from it, average 0.1 oz. silver per ton.

The second theory is that the ore deposition was associated with the great post-volcanic intrusion of andesite which underlies the region. The presence of extensive dikes and stocks of andesite near all the large ore deposits is a strong argument in favor of this theory. The occurrence of the North Tigre deposit in andesite proves that ore deposition followed at least the first manifestation of the andesitic intrusion. On the other hand, andesite dikes which traverse the Sooy vein prove that ore deposition preceded at least the last manifestation of the andesitic intrusion. Conceivably the dikes cutting the Sooy vein were derived from the molten core of the main intrusion, after the cooling exterior had caused the formation of the orebodies. The Sooy and North Tigre ores are sufficiently similar to each other and to the ores of the other veins to indicate the same source for all the ores of the region. It can therefore be argued consistently that the ores of the Tigre district were deposited while the andesite intrusion was solidifying and cooling. Thus the andesitic intrusion fills the modern requirement of a cooling igneous intrusion (preferably basic) as the source of the ore-bearing solutions.

The andesite assays 0.06 oz. silver per ton, and the rhyolite, lying between the andesite and the ore deposits, assays 0.10 oz. per ton. The ground-water at Tigre is noticeably charged with alkaline sulphides.

It is not unreasonable to suppose that the veins were formed by hot alkaline-sulphide solutions, which derived their heat and part of their mineral content from the cooling intrusion. Part of the minerals may have been derived from the rhyolite and other rocks overlying the andesite intrusion.

In connection with the above theory it is interesting to note that the volcanic rock beneath the ore deposits have been greatly altered for a distance of 100 yards or more on each side of the veins. The alterations in the Nodular formation take the form of kaolinization and loss of silica in the groundmass. The Flat formation is intensely silicified. In the Cliff, Tuff, and Tigre formations there is extensive deposition of secondary pyrite. The altered rocks assay less in silver than unaltered specimens of the same rock. A possible explanation is that the ascending mineral-bearing solutions were partly confined beneath the shale in the bottom of the Flat formation, and spread laterally through the Nodular formation, following the lines of weakness between nodules and groundmass. The groundmass has been much leached, analysis showing a marked reduction in silica, iron, and silver. After the solution had finally forced diffusion through the shale of the Flat formation, the pressure was reduced sufficiently to permit the deposition of silica, which is so marked in this formation. On diffusing still higher into the Cliff, Tuff, and Tigre formations, the solutions dissolved more metals. Iron, being the predominating metal in the rocks, saturated the solutions and was precipitated as pyrite in the rock itself. The other metallic sulphides, together with the remaining iron and silica, entered the veins in a manner analogous to lateral secretion, being precipitated on encountering the reduced pressure and temperature of the open fissures.

The above theory is suggested because it appears to explain the relation existing between the veins and the pyritization and silicification of the wall-rock. This relation has been so repeatedly verified by development work that it has come to be an axiom that the ore is to be sought at the horizon where pyrite occurs in the wall-rock, and just above the horizon of intense silicification.

Secondary Enrichment. Secondary enrichment has only slightly affected the orebodies. Most of the ore is primary. This is especially true in the north end of the mine, where the sulphide grains are completely encased in quartzose vein-matter. Here sulphide ore outcrops and shows little evidence of leaching or enrichment.

Farther south the vein is less silicious, and hence more pervious to water. The upper part of the deposit has been leached to a depth of 200 ft. or more. In the leached zone silver ore usually occurs as chloride; only occasionally as sulphide, where the denser portions of the vein lent some protection to the sulphide grains. In the early days of the district a rich gold deposit was found just south of the Brown shaft. The deposit consisted of native gold in an iron-clay gangue. Little silver was present. On the strength of this discovery the company was called the Lucky Tiger Combination Gold Mining Company. Development in depth has shown the silver to be ten times as valuable as the gold. Only the name of the company remains to show that the discoverers thought they had found a gold mine. Undoubtedly, the original silver minerals of the Brown shaft deposit had been removed by the leaching action of surface-waters.

Beneath the leached zone is an ill-defined zone of secondary enrichment. Veinlets of stromeyerite traverse the wall-rock and the original silicious-sulphide ore. In one case a seam of native silver, a quarter inch in thickness, was observed traversing low-grade galena.

Mineralogy. The Tigre ore consists of metallic sulphides or their decomposition products in a gangue of quartz and decomposed or silicified rhyolite. Named in

order of their preponderance the sulphide minerals are: sphalerite, galena, pyrite, chalcopyrite, stromeyerite, and freibergite. The sulphides are invariably much intergrown. Crystals, apparently pure, show traces of other metals on analysis. The rich ore of the Tigre mine is freibergite or stromeyerite containing lead and iron as impurities. The finely crystallized sphalerite and galena are usually intergrown with minute particles of stromeyerite. Hence such ore is generally high in silver. When coarsely crystalline, sphalerite and galena are much lower in silver. Sphalerite generally assays higher than galena. Pyrite is practically barren of silver.

In the oxidized portions of the veins, the important minerals are native gold, native silver, and cerargyrite (hornsilver). A unique occurrence of gold was found in the upper part of Gold hill; it consisted of a druse of fine gold deposited upon a crystal of hornsilver.

Gold is usually associated with chalcopyrite. There is no fixed ratio between gold and silver. One of the samples richest in gold (900 oz. per ton) contained only 100 oz. of silver. Likewise the high-grade stromeyerite ore is practically barren of gold. Only by averaging the production over long periods can any definite relation be found between the gold and silver. For each ounce of gold produced since the inception of operations, the mine has yielded 162 ounces of silver.

Conclusion. The knowledge gained by geologic study has proved of much value in the development of the mine. The study of the stratigraphy of the lava-flows has helped in the solution of fault problems and has served to indicate the horizons at which ore may be encountered. The knowledge of the characteristics of the veins in the various volcanics has made possible more intelligent systems of development and mining. The relation between ore deposits and faults dipping south and west has been another aid in the discovery of ore. Likewise the relation between ore deposits and pyrite in the wall-rock has helped in the search for new orebodies—especially by diamond-drilling. Finally, the fact that the zone of ore deposition lies immediately above the zone of intense silicification, has aided in following the trend of the orebodies and in avoiding unprofitable development work.

In conclusion I wish to acknowledge the participation of C. M. Heron in the preparation of this article. He did much of the field-work and prepared the original maps and sections. The petrographic work was done by Professors George D. Louderback and G. H. Cox. I desire especially to thank L. R. Budrow, general manager for The Lucky Tiger Combination Gold Mining Company for authorization of the work and for constant suggestions and criticisms throughout its progress.

Selenium is a rare and little-known element principally used to give a red color to glass, such as that used on railroads for signal-lights, and in coloring enameled ware. It is also used to overcome the natural green color of ordinary glass. Selenium is peculiar in being a very poor conductor of electricity in the dark and a fairly good conductor in the light and is used in several electrical devices whose utility depends on this peculiarity. It has been used in telephoning along a ray of light and in transmitting sounds and photographs from one place to another over a wire.

The New Cornelia Co-Operative Store at Ajo

*The town of Ajo is built in the desert and consisted of but a few houses when the New Cornelia Copper Co. started operations. Since there were no stores at Ajo or vicinity the New Cornelia Co-operative Mercantile Co. was established to serve the needs of the employees of the New Cornelia and allied companies. The company advanced the money to erect the store-building and to buy the stock, and assumes all risks. In all, $85,000 has been advanced, representing the capital stock of the enterprise.

The store is run by a store manager, appointed by the company, who reports only to the general superintendent. A committee of seven workmen, representing the various departments, meet with the manager monthly and make suggestions for the betterment of the service and present complaints which have been brought to their attention. The store is well managed, carries a large and well assorted stock, and is modern in every respect. Prices are at the same level as in the other South-Western mining towns. The mining company does not participate in the profits of the store, but does receive 6% interest on the capital advanced. At the end of the year, after making proper deductions for interest on capital account, depreciation of store equipment and fixtures, and for a proper sum to the surplus account, the rest of the profit is distributed among the employees of the company in proportion to the amount of their purchases.

To participate in the store profits employees must be in the company's employ at Christmas, when the dividend or rebate is paid, and must have worked four months previous to December 20, when the books are made up. When a man quits he forfeits any interest in the dividend-fund that he may have acquired, and it has been found that this rule promotes the stability of the working force besides reducing the cost of living of the regular employees. The following profits have been distributed by the store to date:

1917 (9 months)	$12,052 to 17[illegible]
1918	32,777 to 57[illegible]
1919	40,825 to 61[illegible]

The average discount has been 15% and about 70% of the men have benefited. Employees, to receive the rebate, must make purchases on credit and all store-accounts are deducted from pay-checks; accordingly no bad debts are accumulated. The store does considerable cash business with others than employees and the profit from these purchases as well as from the business by the men who have quit the company's service, all goes into the general dividend fund.

*Report of investigations, U. S. Bureau of Mines.

Labor the Holder of the Nation's Wealth and Income—II

By W. R. INGALLS

*The report of the Commissioner of Internal Revenue gives some specific figures for 1916 as compiled from the income-tax returns by persons who had incomes in excess of the statutory exemption of $3000. We may assume that roughly as the dividing line between the wage-earning and the high-salaried and employing classes. There were some wage-earners who overstepped this line, but their number was only 2304, and their net income of about $16,000,000 may be disregarded. Besides the corporations reporting, there were 437,036 individuals, comprising investors and speculators, corporation officials and superintendents, manufacturers and merchants, bankers and brokers, engineers, lawyers, physicians, and other professional men, public officials, etc. Here is a distinct grouping of capital and mind as distinct from the mere manual workers. Let us see what they got.

The corporations that made any profit reported an aggregate net income of $8,765,908,984, but the unsuccessful corporations had a deficit of $656,904,411, wherefore the real net income of all corporations was $8,109,-004,573.

Individuals engaged in business, trade, and commerce earned $2,637,474,520, salaried and professional men got $1,851,276,776, while the income from property (such as rents, interest, etc.) not including dividends, was $1,724,-682,062, making a total of $6,213,433,358, from which there is to be deducted $461,243,258 for exemptions that could not be classified, leaving a net individual income in the aggregate of $5,752,190,100, not including dividends. The dividends received by these classes were $2,136,468,-625, and bring their direct income up to $7,900,000,000.

The corporations of the country, although reporting a net income of $8,765,908,984, did not distribute anything like that in dividends. We lack a precise figure for the actual distribution of dividends. Neither the Bureau of Internal Revenue nor the Federal Trade Commission has computed this essential figure. However, David Friday, in a study on 'The War and the Supply of Capital' in the 'American Economic Review' for March 1919, gives this figure as $3,784,000,000. Professor Friday compared the net earnings and the dividends of a large number of corporations, and applied the factor to the $8,765,908,984 total net earnings of corporations as reported by the Bureau of Internal Revenue. The number of corporate accounts summarized laboriously by Professor Friday in arriving at his factor was so large that his estimate for the total dividends made in this way may be accepted as highly probable.

I must digress here to point out a fundamental difference in thought between Professor Friday and myself. He assumes that the surplus of net income above dividends is retained by the corporations for the improvement and extension of their properties, and consequently is an annual addition to the wealth of the country, according to which theory it would be a capitalistic deduction from the produce of industry. I dissent from this, and hold that the apparent surplus is used largely for maintenance of property. Every student of corporate finance knows that neither a railway nor a mining nor an industrial company is ever safely able to distribute as dividends more than a percentage of its 'net income'. If it does, sooner or later it comes to grief. Professor Friday shows that in 1911-'14 the corporations paid only 67% of their net income in dividends, and presumably that was an approximate representation of their true earnings.

It is, of course, undeniable that corporate surplus goes to a considerable extent toward the increase of capital. The finances of the United States Steel Corporation are an illuminating example of the upbuilding of a business in this way. But whether such increase of capital be shown in the displacement of 'water' in an original stock-issue, in the cancellation of bonds or in stock dividends, the only thing that counts in the division of income is the distribution of cash dividends. The only deranging condition is that the actual new capitalization of 1915, let us say, may not have fructified in cash dividends until 1917 or 1918.

It was in 1915 that American industry began to experience great profits accruing from the war in Europe. In that year of large earnings our corporations, according to Professor Friday, distributed dividends only a trifle larger than in 1914, but the distribution was only 49.1% of the total net income, instead of the pre-war average of 67%. In 1916 and 1917 there were large increases in the distribution and further declines in the ratio. This shows clearly the point that I have made as to delayed benefit. I think it may be deduced, moreover, from Professor Friday's figures that the dividends in 1916, 1917, and 1918 were no larger than they were owing to the fact that large parts of the surplus were put into plants that became useless and into inventories that shrank with declining prices. Many companies know sorrowfully how their noble surpluses of 1918 shriveled in 1919. I feel, therefore, that what concerns us in a study of the division of income is simply what was actually paid in dividends.

But these statistics indicate another interesting and important thing. If the dividends of corporations in 1916 were $3,784,000,000, the capitalistic and directing classes got only about 56% of that sum. Whither went the remainder? Manifestly it could have gone nowhere except to those classes whose net income was less than $3000; in other words, to the mass of the people. This leads to the

*From 'The Annalist', of September 20, 1920.

thought of elderly people who have invested their savings and to the wage-earners themselves, and there springs into the mind the knowledge that many workers have invested in the stock of companies, like the United States Steel Corporation, for which they work.

The corporate net income in 1916 was $8,109,004,573, whereof about $3,784,000,000 was distributed in dividends, leaving a surplus of $4,325,004,573. If it be assumed that one-half of that surplus was preserved in such a way as ultimately to accrue to the stockholders, which is a liberal estimate, I think, and that the other half went into maintenance (or was destined eventually to be written off), and if we add in the dividends received by persons of less than $3000 per year income, we have the following summary:

Received by - $3000 class	$7,900,000,000
Received by — $3000 class	1,647,500,000
Retained by corporations	2,162,500,000
	$11,710,000,000

Consequently, it appears as clearly as figures can show that in 1916, out of a national produce estimated at $45,000,000,000 to $50,000,000,000 the deduction by persons receiving incomes of $3000 and upward was about $7,900,000,000, much of which was ascribable to their own efforts, and by corporations was about $2,162,500,000, nearly one-half of which was destined to go to persons of less than $3000 annual income, giving a total of about $10,000,000,000. Everything else, that is, from $35,000,000,000 to $40,000,000,000 or 78 to 80%, was the dividend of the people possessing incomes of less than $3000, and especially was it the dividend of the wage-earners. They could hope to get the remainder only if they acquired possession of all the capital of the country and had all the talented persons working for them as slaves with the same efficiency that they exhibited in working for themselves, which is a preposterous idea. In such an event, however, the people of the country receiving incomes of less than $3000 per annum to whom went nearly half of the corporate dividends in 1916, and a larger proportion of the interest on bonds and notes, would simply be deprived of that income which is derived in large measure from their own savings.

Thus we see that out of the nation's produce of about $50,000,000,000 in 1916 the representatives of capital and mind received only about $7,900,000,000, of which about $3,775,000,000 was from dividends ($2,136,468,625), interest, rents, etc., and about $4,100,000,000 was the result of personal effort in business, trade, commerce, and professional practice. This income by personal effort involves the use of capital to a more or less extent. The manufacturer and trader may use a good deal. The lawyer, physician, and engineer use very little, although their ability to earn is largely based on prolonged and costly education and professional training.

I have made a distinction between the income from agriculture and all other income, for I shall make it clear that radically different conditions exist. According to the income-tax returns for 1916 there were only 14,407 farmers, stock-raisers, orchardists, etc., who made returns; they showed aggregate net income of $129,642,432. Agricultural corporations reported $69,862,431. These returns constituted so small a percentage of the total that they may be disregarded, and it may be assumed that agriculture, engaging the labor of about 14,000,000 men, stands apart from the previous considerations in this paper. The produce of agriculture in 1916, according to the United States Department of Agriculture, was $9,054,000,000 for crops and $4,352,000,000 for animals and animal products, a total of $13,406,000,000, but in these figures there is a large duplication, for a great deal of the product of the fields is fed to animals. According to the census of 1899 about 33% of the crop-value was fed to animals. Professor Friday, in the paper to which I have previously referred, estimates about 30%. I am content to adopt his figure, and assume a net gross value of $10,725,000,000 for farm products in 1916. The value of pasturage, estimated at about $1,000,000,000 by the U. S. Department of Agriculture, appears, of course, in the animal products.

From the gross income of the farms must be deducted, in order to arrive at the labor return, the cost of supplies and materials (such as machinery, vehicles, harnesses, tools, fertilizers, binding twine, etc.) that are the products of other industries. There is no way of determining this, and I am here forced to resort to conjecture, using a certain rough basis. An estimate of $2,725,000,000 for such costs will not outrage probabilities, and will leave $8,000,000,000 as the reward for the labor of 14,000,000 farmers and farm laborers in 1916. According to these figures, the yield per person was only about $571, including not only the remuneration for labor, but also the interest on invested capital. Of the 14,000,000 persons engaged in agriculture about 7,000,000 were farmers in their own right, and about 7,000,000 were hired men. Without any doubt the former received more than the latter.

It will be perceived immediately that there is something wrong with these figures. The quotient is manifestly too small. The statistical evidence in favor of the substantial accuracy of the divisor is preponderating. Clearly the dividend is in error, and it is no stretch of the imagination to conjecture that it does not include the produce that the farmer uses for himself and his hired men. Indeed, anybody who is acquainted with the accounting practices of farmers knows that not one in a thousand of them keeps track of this, or could report it. Therefore, it is clear that the farmer is not really so badly off as the figures indicate; that the actual produce of agriculture in the country is greater than the figures indicate; that in considering the position of the country as a whole agriculture and its returns must be segregated, and that having done so we have to deal with a total produce of about $42,000,000,000 instead of $50,000,000,000. Out of the $42,000,000,000 we have previously seen that about $7,900,000,000 was taken out by the persons receiving more than $3000 net income per annum, and about $2,100,000,000 was retained by corporations. So far our feet have kept on pretty firm ground.

I am now obliged to enter a rather shadowy val-. The

wage-earners will probably disclaim the men earning $3000 per annum as being any of them, and we have seen from the income-tax returns that the number of wage-earners who appeared in the tax-gatherer's list was insignificant. Where, then, shall we draw the line between salaried men and wage-earners, pure and simple? There can be no sharp line. I shall not, however, violate common sense if I draw an arbitrary line at $2000. Even in 1916 there were many classes of mechanics, railway-men, printers, and others who received $6 per day, and could work 300 days per year if they wanted to. Accepting this dividing line, it remains to segregate the share of persons earning from $2000 to $3000, and I am bound to say that I know of no good method for doing this. The Bankers Trust Company, in a pamphlet published in 1918, estimated 1,247,000 families receiving an aggregate of $3,077,425,000 at the rate of $2000 to $3000 per year. Assuming this estimate to be carefully made, it is manifestly too large for my present purpose for it is computed on the basis of the family rather than the person, and undoubtedly includes farmers whom I have segregated. Moreover, this class of persons undoubtedly participated largely in the rents, interest, and dividends that were not received by the capitalistic class. This is, indeed, a zone of great uncertainty; one whereof the conditions cannot be deciphered with the aid of any existing data. In this zone the number of families and workers is probably more nearly coincident than in the class receiving incomes below $2000. I am going to assume that the number of workers in the $2000-$3000 class was 1,250,000, and that they received $3,000,000,000 in 1916 without duplicating anything else in these calculations.† In fact, the number of workers duplicates what will appear in a subsequent list aggregating 41,000,000, and the deduction of $3,000,000,000 will duplicate to a more or less extent the deductions for agriculture, dividends, and interest in the next following table.

I may now usefully summarize this line of reasoning and deduction in a table as follows:

Total produce of the United States, 1916	$50,000,000,000
Deduct net produce of agriculture	8,000,000,000
Total of all other produce	$42,000,000,000
Deduct share of persons receiving plus $3000	7,900,000,000
Total remaining	$34,100,000,000
Deduct retention by corporations	2,100,000,000
Total remaining	$32,000,000,000
Deduct share of $2000-$3000 class	3,000,000,000
Total remaining	$29,000,000,000
Deduct dividends, etc., received by $3000 class	1,000,000,000
Total for non-agricultural wage-earners	$28,000,000,000

As previously pointed out, the sum retained by corporations will eventually go, to the extent of 44%, to the $3000 class. My last deduction, $1,000,000,000, is purely one of conjecture.

The foregoing computation is by no means to be accepted as precise. There was a considerable evasion of income tax by persons just over the line, which has been established rather conclusively in a paper by Professor Friday on 'Statistics of Income' in the 'American Economic Review' of September 1919. Certain governmental officials were exempt from making returns. Finally, the interest on some Federal, State, and municipal bond issues was exempt in behalf of everybody. I believe, however, that my rough deductions for the $3000 classes are sufficiently liberal to allow for all unreturned capitalistic income.

In this connection Professor Friday makes a significant statement that is in line with what has been pointed out herein respecting the division of dividends. He says: "I estimate that the total interest paid by corporations alone during 1916 was $1,700,000,000. The total amount reported by people with incomes of $3000 and over is $667,566,376. We do not know how much of this interest comes from sources other than corporate securities, such as real estate mortgages, but after making some reasonable allowance for these it seems pretty evident that not more than 30 to 35% of the interest-bearing obligations of corporations are held by persons having incomes of $3000, who reported to the Department of Internal Revenue in 1916."

It seems to me that this information is far more portentous than the above conclusion would indicate. If the interest paid by corporations was $1,700,000,000, the total interest, including that on notes, mortgages, and Federal, State, and municipal bonds must have been far greater, and if what the people of plus $3000 incomes received was only about 39% of the corporate interest it must have been a far smaller proportion of the total interest.

Let us now examine the number of workers, other than agriculturists, among whom $28,000,000,000 was shared. With respect to the number of wage-earners in the United States in 1916, a year that is about midway between two census years, there are some conflicting estimates, all of them official. We have the U. S. Census of Manufactures in 1914 giving the number of factory workers in that year. Other governmental bureaus have given estimates for particular industries, year by year. The Public Service Reserve of the Department of Labor estimated the total labor-power (men and women) in the United States in 1917 at 40,100,000. The Provost Marshal General, on the basis of the figures of the first Selective Draft in 1917, estimated the total industrial population in 1917 at 43,282,911. In February 1919, a total of 43,206,912 was estimated.

An examination of the estimates for 1917, with the aid of collateral data, leads me to adopt the following figures as the most probable approximation of the labor power and its distribution among major occupations:

Farmers	7,000,000
Farm laborers	7,000,000
Lumbermen	200,000
Coal miners	750,000
Metal miners and quarrymen	200,000
Petroleum producers	50,000
General laborers	1,000,000
Railroads	2,800,000
Engineers	7,200,000
Transportation	2,800,000

†This estimate, rough though it be, finds strong support as to number in the income-tax returns for 1917, which show that 1,862,132 persons reported net income of $2000 and over.

Trade	1,000,000
Public service	500,000
Private servants	1,000,000
Other not elsewhere included	500,000
Total	11,000,000

This is an industrial classification rather than an occupational. Thus, the clerical class is distributed among the industries in which employed instead of being segregated as a class. Socially and economically, however, the position of the clerk is substantially the same, irrespective of the industry in which occupied. It will be noted, moreover, that throughout this study my thought has been directed to the division of the national income first between the directing and directed classes and next among the directed classes, that is, the great body of workers. My dividing line is purely the arbitrary line of a certain income. This makes no discrimination among those who work alone (for their own account) those who hire one or more helpers, and those who are hired (the proletariat). According to my view there is no economic difference between conditions of how work is done, but there may be distinct social difference. According to the socialistic view the proprietor of a boot-blacking chair, deriving a net annual revenue of $800 from his business and employing a helper, is a member of the capitalistic class. I do not so regard him.

The total number of persons engaged in clerical work is given at 2,000,000 in one estimate, but that figure would manifestly duplicate persons entered under other classifications in the above table, and I have used the figure of 500,000 as a conjectural allowance for those not elsewhere included, arriving at an estimate of the total number of workers that is a little larger than that of the Department of Labor and a little smaller than that of the Provost Marshal General.

From the total of 41,000,000 workers I deduct the 14,000,000 agriculturists, whose position is considered separately. I might with some reason also exclude the persons in public service who do not produce and the domestic servants who are direct producers to only a partial extent and whose remuneration comes largely out of the income of persons receiving upward of $3000 per annum. However, the service classes, public and private, have to participate in the division of national income, and, except those who minister solely to purposes of vicious and wasteful pleasure, they are indirectly producers through promoting the efficiency of the direct. Consequently it may be said that the non-agricultural dividend of $28,000,000,000 in 1916 was shared by 27,000,000 wage-earners, the quotient being about $1040 per person.

The actual average receipt may have been even larger than that for two major reasons, namely: (1) A significant part of what is enumerated as the industrial population is habitually idle, from choice, either a part of the time or all of it. (2) The large class of men, amounting to nearly 10% of the whole, that is engaged in domestic and manual service, and a much larger proportion of the women, receive a large part of their remuneration in the form of board and lodging, which is paid mainly, if not wholly, by the classes enjoying incomes in excess of $2000.

It would be an extraordinarily valuable thing if we could analyze the receipts of labor according to major groups. Unfortunately, there does not exist sufficient data to permit that to be done with anything like completeness. Nevertheless, with the aid of such figures as are available, plus some imagination and conjecture, we may be able to discern the broad outlines of the structure.

According to the U. S. Department of Agriculture, 61.9% of the farm labor is hired "with board" and 38.1% "without board". The average wage in the whole country "with board" in 1916 was $23.25 per month; "without board" it was $32.83. These are arithmetic averages by States, not weighted averages taking into account the relative number of men employed in the several States; nor is there any cognizance taken of the lost time by the laborers employed by the day. However, we may deduce the rough idea that the average income of the farm laborer in 1916 was something like 12 by $32.83, or $394, say, $400, approximately, which by the majority was received partly in money and partly in goods (board). The actual income of this class of workers, which is subject to a great deal of lost time, owing to the seasonal character of its occupation, was probably materially less than that. This is the largest class of workers, numbering about 7,000,000, and is the most poorly paid. If this class received $2,800,000,000 in the aggregate, the 7,000,000 farmers must have got about $5,200,000,000, or an average of about $743 each.

Coal mining is divided into anthracite and bituminous, in which important differences of conditions exist. Unfortunately, I have been unable to find comprehensive statistics of wages in either of these industries in 1916. In connection with the settlement of the bituminous strike in the latter part of 1919 the following statement was issued officially from Washington:

The table below, compiled from data furnished by the Federal Trade Commission, shows the average earnings of mine-workers in the central competitive fields during 1918. This table covers a tonnage for the year of 148,393,227, or 56% of the total production of the central competitive fields and nearly one-third of the total normal production of the entire country.

Tonnage	148,393,227
Labor cost	$197,160,499
Average number of operators	385.8
Average days worked	250.8
Average days worked per month	20.9
Average number of miners per month	68,599.4
Average number of other employees per month	58,554.8
Average number of all employees per month	127,154.2
Total days worked, miners	17,204,729.5
Total days worked, all employees	31,890,273.4
Average tons per day worked, miners	8.63
Average tons per day worked, all employees	4.65
Average pay per day, all employees	$6.18
Average pay per period, all employees	$1,550.56
Average labor cost per ton	$1.33

It is to be noted clearly that the above data are for 1918, not 1916. Dr. Garfield computed the advance in wages from 1914 to 1919 as having been in the ratio of 100:157.6. This would indicate that the average earnings of a great group of the bituminous coal miners, approximately one-third of the total number, were at least $1000 in 1916.

Metal mining, which employed 200,000 men in 1916 (including quarrymen), is a well-paid vocation. In 1916

miners received $3 to $5 per day and were able to work full time. Metal mining is a well-organized industry, in which operations are conducted on a large scale, continuity of work being one of the elements of success. Mines and mills are commonly operated from 300 to 310 days of the year. There are no statistics available respecting the total earnings of metal miners in 1916, but there is much illuminating data.

The most highly paid among the metal miners are those engaged in copper mining in the Rocky Mountain region. In 1916-'17 the Anaconda Copper Mining Co. paid $17,027,720 to 11,442 miners, an average of $1488 per man. The Butte scale determines not only the wages throughout Montana, but also those in the Coeur d'Alene silver-lead district, while throughout the copper districts of Arizona the rates conform closely to it. About the lowest rate of wages in metal mining obtains in the lead mines of southwestern Missouri, where the base rate in 1916 was $2.80 per day in February, rising to $3.10 in November. There can be no doubt about metal mining being one of the more lucrative of the major industries, and I conjecture that the average per man in 1916 was fully $1250.

This is one of the most illuminating revelations of this statistical study. If we exclude quarrymen and miners of miscellaneous substances, we should find that the great metal-mining industry of the United States is conducted by about 150,000 men, producing about 150,000,000 tons of crude ore per annum. Such a performance has been rendered possible only by the mind of engineers and the resources of capital backing them, which have reduced the requirements for manual labor. That the men working in the mines have participated in the benefits is seen from the fact that in 1916 they received an average wage of $1250 (probably), while the railway-man got only $886, the factory worker $675, and the agricultural laborer $400. If the farm could be so mechanicalized as the mine, and if farming could be conducted by great corporations, able to employ talent, there can be no doubt that the number of agricultural workers would be reduced and the average earnings per man would be increased.

Smelters also are well-paid workmen. The Anaconda Copper Mining Co. in 1916-'17 paid its 4793 men at Anaconda and Great Falls a total of $8,558,793.57, an average of about $1800 per man. The American Smelting & Refining Co., however, whose operations are mainly in manufacturing districts rather than mining, paid its 21,073 employees in 1916 an average of only $809.

In the iron and steel industry we find precise figures of earnings in the reports of the big companies. The United States Steel Corporation, Midvale, Republic, and Bethlehem in 1916 paid $359,185,642 in wages to 343,785 persons, an average of $1045 per person. This is not exactly an indication of the earnings of iron and steel workers, for the employees of these companies include miners, coke makers, railwaymen, etc.

Respecting the position of the factory workers we may get some indices from the United States Census of Manufactures in 1914. For that year there was reported a total of 7,036,337 wage-earners, male and female, employed on the average, who received an aggregate of $4,078,332,000 in wages, or about $580 per person. The highest paid were the machinists—the makers of vehicles—who got about $750. Railway shopmen got about $700 and persons engaged in the iron and steel industry received about the same figure. The lowest paid were the textile workers, clothing makers, and tobacco workers, who got only $440 to $450. These lowly paid industries employed the largest proportion of women. In the more highly paid industries, involving heavy work, the percentage of women was least.

These figures do not agree very well with those of the United States Steel Corporation, which, in 1914, employed 179,353 persons and paid them an average of $905. This company's average payment increased to $1042 in 1916. If the wages of all the factory workers of the country increased in the same ratio, a not unreasonable assumption, considering its moderate character, their average earning in 1916 was something like $668 compared with the average of $580 in 1914. The Department of Labor of the State of New York, which obtains direct reports of wages paid, number of employees, etc., in a large number of factories in that State, estimates (in a private communication to me by L. W. Hatch, chief statistician) that total wages of $826,665,000 were paid in 1916 to 1,206,000 employees, an average of about $685 per person. This agrees closely with my estimate of $668 based on the census figures for 1914. It is rational to estimate that the factory workers of the United States received an average of $675 in 1916.

According to the statistics of the Interstate Commerce Commission 1,700,814 railway employees in 1916 received $1,506,960,995, giving them an average of $886 per person.

Professional service, according to the Provost Marshal, occupied about 2,200,000 men. Figures issued by the same authority in February 1919, put professional service at 1,912,093 and clerical occupation at 1,938,906. It is uncertain just what these groups do or do not include. According to the income tax returns for 1916 the number of purely professional men who received taxable incomes was about 70,000. I cannot make any sure deductions from the figures that are available. It looks as though there might be somewhere from 2,000,000 to 3,800,000 men engaged in clerical work and the lower ranks of professional service. These men receive incomes ranging from $3000 per annum down to $500, with an average that is probably higher than those of any of the major classes of manual workers.

Borax is a valuable flux for chemical and metallurgical purposes. It is used in the manufacture of pottery-glazes and enamels, and as a glaze for paper and linen. It is also used in tanning and glue manufacture. Its property of adhering closely to clean surfaces of metal under high temperature and preventing oxidation causes it to be largely employed in brazing and as a flux in brass manufacture. It is also used in the manufacture of soap and glass, and in numerous other ways. As an antiseptic it is used as medicine, and as a food preservative. Borate of chromium is used as a pigment in calico printing.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

FIRST SHIPMENT FROM THE NEW MILL AT THE KINGMAN CONSOLIDATED.

PRESCOTT-JEROME DISTRICT.—Ben Rybon, president of the Silver Belt Consolidated Mining Co., has announced that financial arrangements are complete and operations at the mine which is located half way between Humboldt and McCabe, will be commenced immediately. Twenty-five years ago this mine produced over $1,000,000 in silver. It is said that there are 17,000 tons of ore on the dump and 25,000 tons in the stopes that will average 20 oz. to the ton in silver. It is planned to build a mill and sink the shaft to the 300-ft. level. It is reported that the Shannon Copper Co. is still carrying on development at the Yeager Canyon property and that some ore is being shipped from the company's mine at Gleeson.

Sinking of the Dundee-Arizona shaft, it is reported, will probably be resumed in the near future. Through the efforts of the pumps the water has finally been lowered to the bottom of the shaft, approximately 820 ft. below the collar. Plans are under way to put on three shifts in the shaft and continue sinking to the 900 or 950-ft. level before cutting another station. The new reverberatory furnaces at the United Verde Extension were tried out during the month of August; with the operation of both the reverberatory and blast-furnaces, the total production for this month was approximately 5,000,000 lb. of copper. The average tenor of the ore was 14%.

KINGMAN.—The Walnut Creek Mining Co. has taken over the Harrison group of claims in the Secret Pass district. Grading for the shaft site, head-frame, and hoist is completed. The Harrison group of mines has had some development which has exposed several veins of high-grade silver ore. It is the intention of the new company to sink the shaft several hundred feet. Jack Zwinge is in charge of the work. Contractors are now at work in the shaft of the Old Dad Mining Co. which is being refinanced. The shaft has reached a depth of 10 ft. and exposed a 3-ft. vein. The new electrical machinery has been installed at the I. X. L. mine and sinking below the 265-ft. level is under way. It is the intention to sink to the 500-ft. level at which point lateral development will be commenced. The first carload of concentrate from the new mill of the Kingman Consolidated Mining Co. has been shipped. The company is also shipping high-grade ore obtained from leases. The main tunnel is being driven rapidly, all new machinery now being in place. William Halloran is in charge. The Cyclopic mine has just made an $800 gold-bullion clean-up from the first run of the new mill. Recent development to the northwest, it is reported, has opened a large body of $12 ore. F. Humphrey is superintendent.

BISBEE-WARREN DISTRICT.—Smelter production of the Phelps Dodge Corporation in September was 7,998,000 lb. of copper, compared with 15,500,623 lb. in September 1918. Copper production by Calumet & Arizona in September was 3,038,000 lb., compared with 4,868,000 lb. in 1918. The Shattuck-Arizona company's output for September was 166,513 lb. copper, 921,912 lb. lead, 57,008 oz. silver, and 524 oz. gold.

According to the Arizona State mine inspector, Arizona mines are now employing about 60% of the normal number of men. There are now engaged in and around the mines and mills approximately 20,000 men as compared with more than 30,000 during normal times. One of the large copper-producing companies is reported to be now handling about 130,000 tons of ore per month through its reduction plant as compared to 300,000 tons per month during the peak of production during the War. Other large companies are said to be handling from 40 to 75% of their normal capacities. The U. S. Geological Survey in co-operation with the Arizona State Bureau of Mines, under the direction of G. M. Butler of Tucson, director of the State bureau, has recently prepared a detailed map of the State of Arizona. The map is on a scale of eight miles to the inch and gives valuable geographical as well as geological and mineral data.

VERDE VALLEY.—One of the interesting engineering projects which will be undertaken in Arizona in the near future is the construction of an impounding dam at the Box Canyon, nine miles below Camp Verde, and which it is said may be started as early as next January. The proposed dam will impound water for the irrigation of 90,000 acres of fertile land in the Paradise valley, northeast of Phoenix. It is estimated that the dam will take from two to three years to complete, and next to Lake Roosevelt the reservoir will be the largest artificial lake in Arizona.

AJO.—The September output of the New Cornelia Copper Co. was 3,314,000 lb. Through a judgment of the U. S. court of appeals at San Francisco, reversing a verdict of the federal court at Tucson, the New Cornelia Copper Co. is finally victor in one of the oddest lawsuits known in mining litigation. On November 27, 1918, a number of Mexican employees of the corporation built a fire to warm themselves while waiting for the time to go

to work. The fire was lighted against an old boiler, property of the company, but for some time unused. In the boiler was a quantity of dynamite stolen from the company, and hidden there by the thieves. There was an explosion of the powder with injury to some of the men. The widow of Jesus Maria Ochoa, killed, sued for damages, after refusing an offer of settlement by the company, which, however, at no time assumed any degree of responsibility. She was given $10,000 in the lower court, but the appellate court failed to find that responsibility attached to the defendant, and reversed the decision.

Globe.—The disseminated orebody on the Castle Dome has been prospected by diamond-drill borings for a length of more than 3000 ft., and shows an average copper content of 1.4%. A capping, 20 ft. thick, is estimated to contain 1,000,000 tons of ore of the same character carrying 2½% copper. At the Superior and Boston a force of 125 men is employed on development and extraction of ore, which is shipped to the El Paso smelter, and the International at Miami.

Clifton-Morenci District.—The Morenci branch of the Phelps Dodge Corporation is still further curtailing its prospect and development work. It is over a year since this company ceased production and was put on a purely development basis. During this period the mill and smelter have both been closed down. Incidentally, plans have been under way regarding a consolidation of this company's property with that of the Arizona Copper Co., which has extensive ore-reserves, but as yet nothing definite has materialized. The working force of the Morenci branch of the Phelps Dodge Corporation has been cut to about one-third of its former number.

COLORADO

THE COLORADO CONSOLIDATED INCREASES THE CAPACITY OF ITS MILL.

Cripple Creek.—Drilling has reached 1300 ft. depth in the formation test, the core showing granite with slight fracture. The drillers are making about 20 ft. daily. The district mines report serious labor shortage with more miners leaving the district than returning, a condition not expected after the harvest season.

Idaho Springs.—The unwatering of the Little Mattie shaft by the recently organized Commonwealth Silver Mines, Inc., is progressing. The mine and mill are being electrically equipped and heavy production will follow. The Golden Edge property, controlled by this new company, has ore of smelting and milling-grade exposed in both shaft and tunnel workings. The mill at the Reynolds property at Alice is to be enlarged to handle ores from the Reynolds and Meteor mines.

Silverton.—Albert Kolz, former superintendent, has leased the Hamlet and is adding a flotation-unit to the mill and erecting a tram for the transportation of ore from the tunnel mouth to the mill. The ore carries silver, lead, and copper ranging in value from $20 to $100 per ton. The property has been idle a long time. Magnet lessees are mining ore containing gold, silver, and lead and are preparing a shipment for the smelter. During September, 76 cars of ore were shipped from Silverton mines, the Sunnyside leading with 42 cars.

Lake City.—The Home Mining Co. is constructing an ore-house and blacksmith shop at the Little Chief, adjoining the Pelican, a steady producer of the Lake City district.

The Colorado Consolidated Mines & Power Co. is increasing the capacity of its plant at Sherman; the mill is being changed from chlorination to concentration with a flotation-unit.

MICHIGAN

COAL SUPPLIES AMPLE FOR THE WINTER.

Houghton.—Superior Copper is about to suspend, temporarily at least, until costs get to lower levels. High freight-rates are largely responsible for the suspension, because all material must be transported over the Mineral Range railroad. For the past four or five months, Superior has been shipping about 2000 tons per month, practically all of which came from the 31st level, north and south of the shaft, and cross-cuts across the formation where copper-bearing 'rock' was sought, both in the Superior and West lodes. It had been proposed also to extend the 33rd level drift both north and south from the 31st level winze in the hope of opening ground that would yield a profit.

Prevailing high prices for supplies and labor, coupled with scarcity of labor, has resulted in temporary suspension of operations at the Michigan mine. There is little likelihood that the property will be re-opened until there is a decided change in conditions. Physically the mine is in splendid shape. The openings on the 4th, 5th, 6th, and 7th levels have disclosed encouraging ground on the Butler vein, while the openings on the Omega and Evergreen lodes are promising. An important feature is the unusual width of the Butler, which is 30 to 80 ft. Ordinarily a lode rarely exceeds 40 ft. at the outside and there are mines on the Lake that consider 20 ft. wholly sufficient. With the small force that has been employed for the last six months, Michigan has been producing from 110,000 to 180,000 lb. per month. Under favorable conditions it is believed the output could be easily doubled.

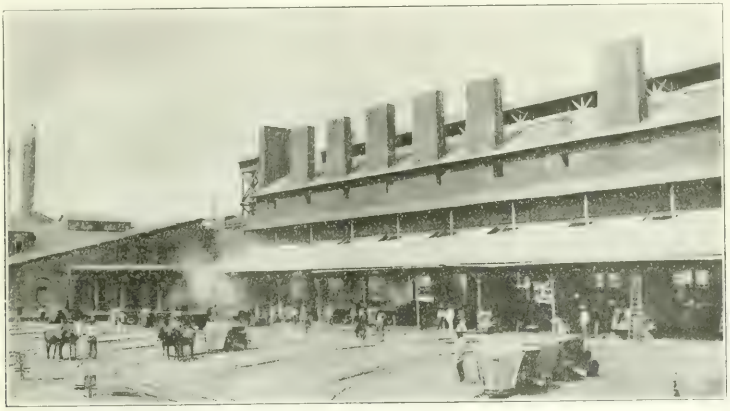
The Lake copper mines now have coal enough on hand for about 60% of their needs for the winter on the present operating basis, which is about 60% of normal. Coal shipments have been coming in at the rate of approximately 140,000 tons per month for the last two months, and if this rate is continued until December 1 the coal supplies for the mines, mills, and smelters will be ample. The advance in freight-rates has been a serious proposition for local mines that do not own their own railroads and it is one that is far from solved. Calumet & Hecla, owning its own line, is not affected, but some of its subsidiaries, including Ahmeek, Osceola, and Superior, are hard hit. Under existing rates it is costing Ahmeek $14.50 for each car of 'rock' that is hauled over the Mineral Range railroad, or approximately $700 per day.

The freight on coal is $22 per car and this item alone represents upward of $2500 per month. The rate on Allouez rock is the same as Ahmeek's, and as soon as the mine resumes work on the old schedule of operations its cost for hauling rock will be about $400 per day. North Kearsarge No. 4 shaft is in the same class, while the shafts to the south are in a different one and accordingly their rate is slightly lower. Centennial, when operating at capacity, also will have to pay a large freight bill, both for ore haulage and coal transportation. The Calumet & Hecla has had under consideration the building of a railroad between Lake Linden and the Ahmeek mine to serve its subsidaries, but no definite conclusion has yet been reached. A preliminary survey of the 7-mile route was made several years ago.

September shipments of copper, by boat, including about 1000 tons that went from the Calumet & Hecla smelters to France, totaled 7,274,000 lb. This compares with 16,860,000 lb. in August and slightly over 10,000,000 lb. in July. The shipments this summer, exclusive of small quantities that went out by rail, totaled 44,834,000 lb., considerably less than was produced during the same period. Tonnage records for the Calumet & Hecla subsidaries reflect a decrease in the output of the old Osceola, which reported 4650 tons for the month. This is due to the recent reduction in the working forces, incident to the operation of the mine on the one-shift basis. The North Kearsarge branch of Osceola, however, is holding well up to the normal of the year with 37,500 tons for the month. Ahmeek's production for the month was the most promising of any of the Calumet group, for 72,050 tons was shipped. On a yield of 22 lb. per ton this means a refined copper product of 1,607,000 lb., the equal of the August record.

It will be late spring before the Calumet & Hecla has a sufficient number of underground scrapers in operation to make any material difference in output, but the work of constructing them will be started at once. In addition to three or four models in use in the parent mine, in the conglomerate, one has been sent to Ahmeek, where it is operating with splendid results. Unlike some of the models that were introduced two or three years ago, the new scrapers are comparatively light in construction and can be employed in any stope. The principal drawback of the shovels used in some of the other mines was the size and weight.

Mayflower-Old Colony has encountered some highly mineralized ground about 200 ft. from the shaft in the south drift. It is regular amygdaloid material, containing small bits of copper not unlike that in the vein when it was first opened on the 1700-ft. level. The most encouraging feature of the operations in the south drift, however, is the indication that the formation is becoming regular. There is a likelihood that the disturbed zone has disappeared. Wolverine soon will begin to blast out the concrete dividers and stringers from the 32nd to the 35th level, because of the fact that the pillars have been moving and crushing, just as occurred from the 27th to the 29th level in No. 4 shaft. Operations at Wolverine still consist in widening out stopes and drifts, cutting out vein-matter along the foot-wall in recent and older workings, and regular stoping north and south of both shafts. The cutting-out process netted more than 30% of the ore shipped to the mill last year and this work promises to yield equally as much during the present year. Like Mohawk, Wolverine could use many more miners and trammers. The production of each is 50% of normal. Ultimately Mohawk will have mastered the trammer problem by the use of the stope scraper, mechanical and rope haulage, and a level-scraper. It is proposed to install stope scrapers in Mohawk as soon as the price of material drops. As long as the metal market holds around present levels, there will be no special effort to increase the output of either mine. Mohawk's openings are as extensive, if not greater, than a year ago at this time, while Wolverine during the past six months has prepared to cut out the vein from surface to the 19th level.



LEAD SMELTER OF THE CIA. METALURGICA, SAN LUIS POTOSI, MEXICO

NEVADA

CONSOLIDATED VIRGINIA WILL RE-OPEN THE 2250-FT. LEVEL.

DIVIDE.—The presence of Jackling-Hayden, Stone & Co. engineers lends color to the report that Easterners are heavily interested in the Tonopah Divide and that the mine will be re-sampled for them. H. C. Brougher, president of the company, also is at Tonopah. The Tonopah Divide will stop shipping to the MacNamara mill on November 1 and from that date the ore will be sent to the Belmont mill, where it will be treated at a lower rate than is charged at the MacNamara. After November 1 shipments will be made at a rate of 50 tons daily, or 15 tons more than the present rate. The cross-cuts on the 800 and 1000-ft. levels are now within 50 ft. of the vein.

TOLICHA.—The Loring interests have taken an option on the Landmark group of three claims, owned by Thomas A. Harney, Edward S. Harney, Edward Yeiser, Nick Ableman, Edward Ashton, and others. Neither the terms of the option nor the purchase price have been announced. The closing of the deal ends negotiations of several months and it is reported that the holders of the option have secured full control, with the right to do whatever work is considered advisable. Charles D. Wilkinson, engineer for Loring, has completed a second sampling of the claims. Tolicha is 45 miles south-east of Goldfield, the nearest important town, and is 12 miles from the Tonopah & Tidewater railroad. The claims contain seven veins, three of which have been prospected at a depth of 50 ft. by a tunnel. Reports of remarkable widths of high-grade gold ore in the Landmark group frequently have come from the district.

VIRGINIA CITY.—Driving of the tunnel of the United Comstock has been started from the portal on American Flat and it will be continued by three shifts. The company is reaching through several shafts other places from which the tunnel will be driven. The Consolidated Virginia has started to re-open the 2250-ft. level to prospect for the extension of the ore-shoot now being mined through a winze from the 2150-ft. level. A drift from this winze continues to open ore.

BARCELONA.—In the fourth annual report of the company, Jules V. Barnd, president of the Spanish Belt, says that the building and the foundations for the machinery for the 50-ton mill have been completed and that the machinery will be moved to the mine in the very near future. The plant will have 10 stamps and concentration and flotation will be used. The ore contains silver and lead and it is estimated that the extraction will be 90%. There is 75,000 tons of 'probable ore' in the mine, assaying $20 to $30 per ton, according to the report. The company plans to ship the concentrate by auto 60 miles to the Tybo smelter.

MONTEZUMA, ESMERALDA COUNTY.—Edwin S. Giles of Goldfield has been employed as manager for the Montezuma Silver Mines Corporation, succeeding Arthur H. Cooper. The mine has been practically closed but the 240-ft. Caracas shaft, in which no work had been done for 45 years, is being re-timbered as the first work under the new management. Work at the Arizona shaft will not be resumed for several months. The Montezuma is an old silver-lead producer. The 305-ft. Arizona shaft was sunk in recent years, but all of the late work has failed to open an orebody. Several months ago the company shipped a carload of ore, but the return was much lower than had been expected.

HAWTHORNE.—Work in the Lucky Boy, west of here, is to be resumed. This will be the first real effort in 10 years to develop the mine. Little, except the re-timbering for 350 ft. of the 6500-ft. drainage tunnel, has been done by the company since 1915. This tunnel is connected by a raise with the 700-ft. Hubbard lease shaft and it will be in the vicinity of this shaft that the first mining will be done. The Hubbard was a bonanza lease in the early days, but sinking of the shaft was stopped when the water-level was reached at 700 ft. The drainage tunnel reaches a depth of more than 1000 feet.

RENO.—Complete electric equipment is being put in place at the Black Panther, a copper-silver-gold mine three miles north of here, and when this has been completed the shaft, now 200 ft. deep, will be continued to 500, with stations for lateral work at 100-ft. intervals. A four-mile electric-power line is being constructed to the mine.

ARROWHEAD.—A 35-hp. gasoline hoist and a 40-ft. steel head-frame have been bought by the Arrowhead for use in sinking the shaft 100 or 200 ft. from the present depth of 265 ft. Shipments of $150 to $200 ore continue to be made to Tonopah. There is in the bottom of the shaft 18 in. of $170 ore. Mark G. Bradshaw is now consulting engineer.

ROUND MOUNTAIN.—Shortage of water again retarded the operations of the Round Mountain in the placer field during the season this year and lode mining has been discontinued by the company because of the high cost of supplies. However, the lode mine is being developed on a good scale by lessees and to September 1 it had produced $40,000. The placer mine produced $53,000 to September 1. The Fairview mill produced $99,500 gross, $34,000 net, to September 1.

ROCHESTER.—On application of a Lovelock mercantile company, a receiver has been appointed for the Nevada Packard Mines Co. The indebtedness is $53,000. The application for a receiver, a friendly proceeding, was made after the mine and mill had been closed for two months because of lack of power due to low water in the Lahontan dam at Fallon. During this period the capacity of the mill was increased from 150 to 225 tons daily and improvements were made in the mine. The receiver, Herman Davis, formerly superintendent, expects to resume work before November 1.

PIOCHE.—A meeting of mining men in this district was called on October 9 to discuss the effect of the increase in freight-rates on the mineral industry of this district. The meeting was largely attended. For a number of years past, the Pioche district has supplied the Salt Lake Route with approximately 400 to 500 tons of ore per day

for shipment to Utah smelters, and unless a lower freight-rate is granted, there will be a continuation of the decrease in shipments, which is already noticeable. A number of constructive suggestions and inquiries were brought up at the meeting, among which was the building of a sampling-mill at Pioche and the mechanical mixing of the ores to take every possible advantage of the existing rates, and also the pooling of ore tonnage on contracts. Shipments are nearly 50% below normal as a result of the increased freight-rates. During the week ending October 9, the Prince Consolidated shipped 950 tons; Virginia Louise, 400; Bristol Silver Mines, 150; Black Metals, 110; Emerick-Deerfoot Lease, 85; Combined Metals, 50; S. T. Campbell, 50; making a total of 1795 tons.

MARBLE.—The Rural Mines, Inc., which has been operating extensively in Mohave county, Arizona, is now opening up the old Lodi mine. The mill has been overhauled, and necessary changes made, under the direction of G. E. Bateman and T. D. Walsh. It is the intention of the management to start milling operations before November 1. At present the ore-reserves are sufficient to supply the mill for two years, but development will nevertheless be continued actively. The present mill has a capacity of 25 tons per day; as soon as the proper flow-sheet has been determined, another milling unit, doubling the present capacity will be added.

EUREKA.—For the week ending October 9, the following shipments of ore and speiss, in transit to the Utah smelters, for reduction, went out over the Eureka-Nevada railway to Palisade, the cars carrying approximately ten tons each: from Eureka-Holly mine, 13 cars of ore; Cyanide mine, 3; Eureka-Croesus, 6; Eureka Prince, 5; from the old Silver West smelter dump, 3 cars of speiss; Eureka Consolidated smelter dump, 29 cars.

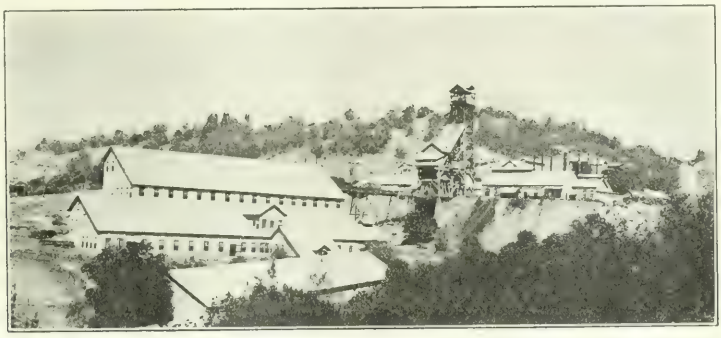
ADAMS HILL.—The Fraser brothers have finished several hundred dollars worth of work, cleaning out adits, drifts, etc., in advance of more important work planned for development in the near future, on the Altoona, Mohawk, and Loudown mines on Adams Hill, which have yielded large quantities of highly silicious ores that have assayed in carload lots up to and beyond $100 per ton.

UTAH

NEW HOISTING EQUIPMENT AT THE LEHI-TINTIC AND TINTIC PAYMASTER.

SALT LAKE CITY.—About two months ago, fire broke out in Sunnyside mine No. 2 of the Utah Fuel Co. at Sunnyside, and rescue-car No. 11 of the U. S. Bureau of Mines has been there continuously to assist in fighting the fire. The mine is now being opened, and G. C. McElroy, the engineer in charge of the car, is on the ground to take personal charge of the work and make investigations for the Bureau. During the week ending October 9, the Murray sampler of the Utah Ore Sampling Co. released 73 cars of ore from Utah mines, 11 from Nevada, 2 from California, 1 from Colorado, and 1 from Montana. The Tintic sampler of the same company released 35 cars of ore from Utah mines.

LOGAN.—A large body of magnesite ore is being developed in the Wasatch mountains, about 6 miles northeast of this city, according to Otto Hudson, who is operating the property. The initial shipment was made recently. This is the first magnesium carbonate to be discovered in Utah, and only two other States—California and Washington—are producing this kind of ore. It is reported that the deposit is 250 ft. thick and 1500 ft. long, and Mr. Hudson states that extensive operations are contemplated.



KENNEDY MINE, AMADOR COUNTY, CALIFORNIA

ALTA.—The Prince Alta Mining Co. has begun suit in the Third District Court at Salt Lake City against the Alta Consolidated Mining Co. to recover for 6000 tons of ore, valued at $360,000, alleged to have been unlawfully and secretly extracted from the property of the plaintiff company. It is alleged that secret extraction of ore from the Christina Johnson claim began January 1, 1917, and that the ore was taken out through the workings of the defendant company. The plaintiff asks that judgment for damages in three times the amount of the actual value of the ore be allowed and that an injunction be issued against further working of the property in litigation.

BINGHAM.—The directors of the Utah-Apex Mining Co. have declared a dividend of 25c. per share, payable No-

vember 1. This will call for the payment of $132,050 and will bring the grand total up to $1,254,475. This is the first dividend disbursement in two years. Federal Judge Tillman D. Johnson has not yet announced a decision in the case of the Utah Apex Co. v. the Utah Consolidated Co., which was heard in Salt Lake City last spring. The company is now sinking a shaft to the 2000-ft. level, where the downward extension of the orebody now being mined on the 1800-ft. level will be opened. In addition to straight smelting-ore, the company is producing a quantity of low-grade ore, which is being handled in its mill, and the silver-lead concentrate is shipped to the Murray smelter. Like all other mining companies in this district, the Utah-Apex is short of skilled miners and could use 100 additional men. About 250 men are now employed by the company. During the first seven months of the current year, the Bingham Mines Co. and its subsidiaries earned $238,149 after taxes, depletion, and depreciation, or the equivalent of $1.59 per share. Net quick assets on August 7 were $446,959, or approximately $3 per share, most of which was cash and demand loans.

Eureka.—During the week ended October 9, the mines in this district shipped a total of 142 cars of ore. The Chief Consolidated shipped 37; Tintic Standard, 27; Mammoth, 26; Dragon, 11; Eagle & Blue Bell, 8; Iron Blossom, 6; Victoria, 5; Iron King, 5; Swansea, 3; Gold Chain, 3; Gemini, 2; Blue Bell, 2; Grand Central, 2; Eureka Hill, 1; Centennial-Eureka, 1; Yankee, 1; Griggs-Huish, 1; and Ridge & Valley, 1. A contract for 100 ft. of sinking in the shaft at the Central Standard property has been awarded, according to John W. Taylor, who is in charge of the property. The shaft now has a depth of 575 ft. and the sinking is costing the company about $30 per foot. During the last 100 ft. the shaft has been in solid limestone, which now shows considerable iron. J. Will Knight and Thomas Pierpont, of Provo, and their associates, control this property. At the Copper Leaf property, which is also under Mr. Taylor's supervision, several hundred feet of drifting has been done on the 100-ft. level. The drift is now being pushed to the north-west, and the face is about 1100 ft. from the shaft. Work is to be resumed at the property of the Tintic-Delaware Mining Co. in the western part of this district, according to John F. Rawson, former secretary-treasurer of the company. About two years ago, disagreement among the directors resulted in the suspension of operations. The company is one of the promising and well-known properties in the western part of the camp, and it is reported that there is a considerable quantity of ore averaging 12½% lead developed in the mine. Streaks of ore averaging from 30 to 70% lead, with 5 to 70 oz. in silver per ton, have been found in various winzes. The company is planning to resume both sinking and drifting. The new hoisting equipment at the property of the Lehi-Tintic Mining Co. has been received and erected. It is capable of handling shaft-work for a depth of 1000 ft. Charles Zabriskie, who is in charge of the property, stated that a shaft will be sunk 400 or 500 ft. from the lower tunnel-level. H. G. Snyder, manager for the Tintic-Paymaster Mining Co., reports that an electric hoist, with a capacity of 1200 ft., has been installed and sinking commenced. About October 1, the work of cutting a station on the 375-ft. level was completed, and vigorous development will be carried on during the coming winter. At a meeting of the directors of the Chief Consolidated Mining Co. on October 15, a quarterly dividend of 10c. per share was declared, payable November 1. This will call for the payment of $88,423, and will bring the grand total of such disbursements up to $1,871,517.

Park City.—Seven mines in this district shipped a total of 1707 tons of ore during the week ending October 8, of which the Judge M. & S. Co. produced 554; Silver King Coalition, 541; Ontario, 259; Daly-West, 117; Keystone, 83; and Naildriver, 60. A shipment of 40 tons of premium spelter was made by the Judge smelter. Work has been resumed on the 2000-ft. level at the Ontario mine, the deepest in the property. About a month ago, the breaking of a crank-shaft on the compressor caused suspension of work, with the result that the lower levels were flooded. A new pump has been installed, and the water has been pumped out. An exceptionally promising strike was reported to have been made on the 2000-ft. level at the time of the accident.

Big Cottonwood Canyon.—Development work at the Big Cottonwood Coalition Mines Co. is approaching an interesting stage, according to C. E. Robertson, secretary-treasurer. The main working-adit, now in the formation over 3200 ft., is rapidly nearing its objective. The face, which is about 600 ft. from the Copper King fissure, is showing increasing mineralization. This company owns a total of 74 claims, adjoining the Woodlawn and Prince of Wales mines. Recently a survey of the property, both underground and surface, has been completed by Robert Gorlinski, the company's engineer, and all the claims relocated. During the past year the company acquired the old Copper King property, consisting of 23 claims. Conditions at the Cottonwood King property are promising, according to S. A. Parry. The Sunnyside fissure, which has been reached, shows several inches of lead-silver ore on the hanging-wall side and on the foot-wall side about 8 in. of the same kind of ore, which is in a decomposed blue limestone. The fissure, which is about 8 ft. wide and striking north-west, should intercept the Congor fissure in 20 to 25 ft. The working-face is a blue limestone and lime spar, showing seams of lead and silver with copper stain, and is considered favorable to the finding of ore.

BRITISH COLUMBIA

DEPLETION OF ORE-RESERVES MAY BE RECOGNIZED IN TAXATION OF MINES.

Hazelton.—The 1000-ft. tunnel at the Babine Bonanza has cut a 34-in. lode, 17 in. of which is high-grade, an average of 10 assays running $236 per ton. The assays ranged from $2 to $20 in gold and 132 to 358 oz. in silver per ton, and from 3 to 7% copper, 3 to 19% lead, and 2 to 22% zinc. The remainder of the lode is milling-ore.

Another tunnel is to be started at a lower level, and arrangements have been made to continue the development throughout the winter. The Steamship Mining Co. has bonded the Paddy Higgings property, on Babine mountain, and has started to develop it by a tunnel. There is a good surface showing.

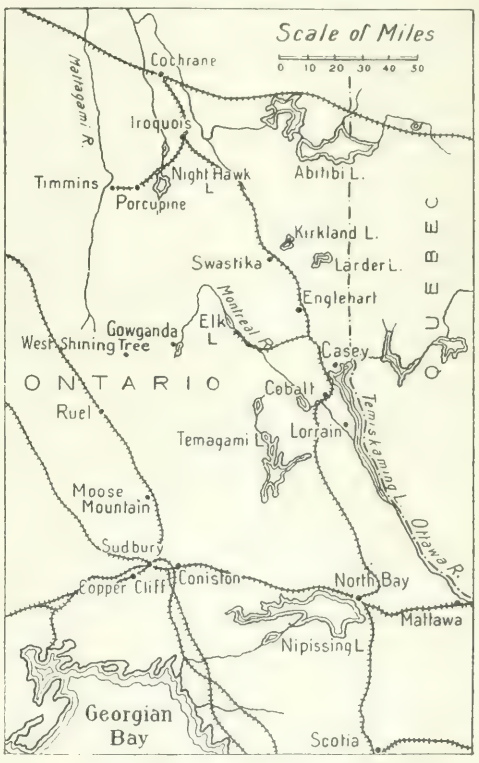
PRINCE RUPERT.—Diamond-drill exploration at the Spider group, Salmon River district, has been so satisfactory that the Algunican Development Co., which has a bond on the property, has established a permanent camp, and will continue development through the winter. Work at the Forty-Nine group, in the same district, has been suspended indefinitely. Officers of the company state that work will be re-started as soon as suitable roads have been made, but that under present conditions transportation charges are too high for profitable work. R. G. Leckie has let a contract for a tunnel and a shaft at the Hercules group, Salmon river, and work will be started at once. Assays from a new discovery on Glacier creek, Bear river, have given returns running between $320 and $400 per ton. A small consignment of high-grade ore from the Esperanza group, Alice Arm district, is awaiting shipment to the Tacoma smelter. The Moose mine and the Silver Tip Extension, in the same district, are said to be developing well. What is required at the present time for the development of the numerous small properties in the mining districts within easy reach of this city is a sampling works, where trial shipments of a few tons could be sent and accurate returns obtained.

GRAND FORKS.—The shaft at the Molly Gibson, at Paulson, is being deepened, and is being sunk on a 7-ft. vein, which assays $80 per ton in gold and silver. A tunnel also has been started to connect with the deepened shaft. Philip B. Freeland, district mining engineer, visited the Gloucester group recently, where the government diamond-drill is in operation, and reports that satisfactory progress is being made. The drill is being used to explore a pyroxenite belt carrying chalcopyrite in bunches and veinlets, and in places the chalcopyrite has been found to contain from a trace up to 0.38 oz. of platinum.

CRANBROOK.—The Consolidated Mining & Smelting Co. has started preliminary work for a concentrating plant to treat its Sullivan mine ore on the site of the old smelter, at Marysville. It is understood that the experimental work that has been undertaken at Trail has been practically completed, and a satisfactory concentration process has been devised for the treatment of the ore. The first unit of the plant is to have a capacity of 2500 tons of ore per day. Up to now only grading work has been done.

SLOCAN CITY.—The long-lost vein at the Evening Star mine at last has been recovered. On the advice of F. J. Parker, formerly manager of the North Star mine, at Kimberley, who now is acting as consulting engineer to Hugh Sutherland, owner of the Evening Star, a cross-cut was driven from about the middle of the tunnel that had been driven in an effort to re-locate the lode, and in this cross-cut the vein was found. The vein where cut contains the same rich streak that characterized it in the upper workings of the mine.

VICTORIA.—Representatives of the mining operators of British Columbia are anxious to induce the Provincial government to amend the Taxation Act in order that allowance may be made for the depletion of ore-reserves in mining property. As it now stands, anything that is allowed comes as a concession from the Minister of Finance after an investigation. The opinion among mining men is that the principle of allowance for depletion of ore-reserves should be recognized in arriving at



THE COBALT DISTRICT

the basis for the taxation of a producing mine. A delegation from mining companies interested in this Province recently met the Premier to discuss this and other phases of the Act. The hearing given them was sympathetic and they are confident that the desired amendments will be made at the next session of the legislature.

Instructions have been given the Provincial Mining Engineers to prepare to deliver a series of lectures at the different centres of their several districts during the winter, the idea being to give prospectors an opportunity to obtain the knowledge necessary to guide them in selecting prospecting-ground and to enable them to recognize valuable minerals. This policy follows a suggestion from the Prospectors' Protective Association. W. E. Cockfield

of the Geological Survey has returned from the Keno Hill district. He says that much development is being carried on by the Yukon Gold Co., one of the Guggenheim enterprises. The company expects to ship 3000 tons of ore this winter. The ore was high-grade silver-lead, running 200 oz. silver per ton and from 50 to 60% lead. The principal minerals were galena, siderite manganese, and occasionally freibergite. The gold content was small, not exceeding, as a rule, $4 per ton. On the upper Stewart river there were some stamp-mills in operation, but little placer mining was being done. A gold-dredge had been in operation on Highett creek during the summer. A shipment of ore from the Nettie L. ran $290 in silver per ton, while othe shipments have given returns of 21 oz. gold, 230 oz. silver, a considerable amount of lead, and a small amount of zinc.

A local syndicate has been developing a talc property on the Port Alberni line of the Canadian National railway. At the present time it is producing about two cars of talc per week.

TRAIL.—During the last nine days of September ore receipts at the Trail smelter, of the Consolidated Mining, Smelting & Power Co., aggregated 12,744 tons, bringing the total for the year at 251,735 tons. The Washington mine, of Sandon, is added to the list of shippers. Mines of the smelter company contributed 11,549 tons of the total, leaving 1195 to the credit of independent operators.

STEWART.—W. R. Tonkin, president of the Fish Creek Mining Co., is quoted as stating that seven years work on its property, west of Salmon river and on the American side of the Portland Canal area, has justified a continuance of work and that shipment of ore will commence as soon as transportation facilities are secured. The lodes are quartz fissures carrying silver and gold and it is proposed to build a concentrator. Mr. Tonkin declares that as large a tonnage of ore will be developed on the American side of Salmon river as within Canadian territory, affirming that it has been only because of the remarkable showing of the Premier mine that the adjoining section has not received the attention its merit deserves. About 600 ft. of diamond-drilling is to be done on the Titan group of claims on Fisher creek. This property possesses a well-defined quartz vein. The Riverside group also has been under development, 350 ft. of tunneling having been done with satisfactory results. At the Premier mine the concentrating-mill, which will have a capacity of 100 tons per day, is making good progress.

ONTARIO

McINTYRE PORCUPINE AND TEMISKAMING PURCHASE COAL MINES.

TORONTO.—Notwithstanding the issue of an Order in Council by the Ontario government on December 18, 1919, relieving the claims staked by returned soldiers from forfeiture for non-performance of assessment work until January 1, 1921, such claims have in several cases been thrown open by mining recorders and re-staked and assessment work done by other parties. The attention of the Minister of Mines having been drawn to the matter, instructions have been issued to protect such claims and reinstate the original holders.

PORCUPINE.—An interim report issued by the Hollinger Consolidated for the period between January 1 and September 8 shows that, with fewer employees and a lower tonnage than last year, the profits of the company have nevertheless increased. The net profits were $2,581,373 from the treatment of 1838 tons of ore, as compared with $2,408,209 from 1902 tons of ore during the corresponding period of 1919. The average number of men employed was 1838, as against 1902. At the annual meeting of the McIntyre on October 7, R. J. Ennis, general manager, said that exploration of vein No. 7 had resulted in the discovery of an extensive orebody between the 1375-ft. and 1600-ft. levels, which had been penetrated at two points 900 ft. apart and was found to contain ore yielding from $13 to $14 per ton. It was described as being richer than vein No. 5, so far the chief source of McIntyre ore, which has yielded 900,000 tons averaging about $10 per ton. The work of de-watering the Vipond-North Thompson property has been commenced. As soon as it has been effected it is planned to put down the shaft from the 600-ft. level to a depth of 1100 ft. and open up levels at every 100 ft. In the meantime there is sufficient ore on the 600-ft. and upper levels to keep the mill working at capacity. On the Miracle property, controlled by the Miller Independence interests of Boston Creek, the diamond-drill is reported to have passed through a 40-ft. body of $11 ore.

COBALT.—Adolph Lewisohn, president of the Kerr Lake, stated in his report that, due to the gradual exhaustion of the ore-reserves, production had been considerably less than in the preceding year and the cost higher. The mine is now producing a relatively small amount of silver and no definite estimate can be made as to how long this will continue. The Mining Corporation, which holds a lease on the old Foster property and is getting out good ore, is undertaking further exploration work by diamond-drilling. The Penn-Canadian, formerly a producing mine, which has been closed since last summer, has been taken over on option by F. C. Sutherland & Co., of Toronto. It has a pile of about 200,000 tons of slime and sand and about 8000 tons of low-grade ore underground. The shareholders of the Temiskaming Mining Co. have approved of the company's joining the McIntyre-Porcupine Mines in the purchase of two coal properties in Alberta, one of which is to cost $600,000 and the other $1,500,000. The Temiskaming has a treasury surplus of about $1,000,000, while the McIntyre's surplus amounts to $1,500,000. The decision to enter the coal business on a big scale is an expression on the part of the stockholders of a bid for the perpetuation of the Temiskaming at the expense of present dividends.

A fourth vein has been found on the Kerr Lake mine, running parallel to the three high-grade veins reported last week. During the fiscal year ended August 31 the Kerr Lake produced 956,049 oz. of silver at an average cost of 56.04 cents.

CALIFORNIA

Amador County.—Unwatering of the Kennedy mine at Jackson is progressing rapidly. The water has been lowered below the 2800-ft. level. There was some delay during the past week, caused when one of the large water skips got caught in the shaft and tore out some of the timbers. The broken sets have been replaced and smaller skips are being used for bailing and will continue to be used until the large skip is altered to make its use safe. The shaft is reported to be in first-class condition.

Mono County.—Application has been filed by C. F. Wildasin of Bishop for 1 cu. ft. per second from the drainage water from the Mammoth mining tunnel for power purposes. Total amount of power to be developed is 73.8 hp.

Nevada County.—The Empire Co. is re-opening its Pennsylvania unit, the closing of which was brought about by the power shortage. Between thirty and fourty men have been placed on shift during the last few days. According to the management, the allowance of power has not been increased, but it has been found practicable to utilize compressed air from the Empire, the two mines being united underground. The Idaho-Maryland mine has now been unwatered to the 1200-ft. level, a gain of 100 ft. having been made during the last few days despite the power shortage. The installation of an electric pump in the incline shaft branching from the 1000-ft. vertical shaft has been completed, and rapid advance in unwatering is anticipated.

Plumas County.—The Seneca Eureka mine, in the Seneca district, about five miles from Lake Almano in one direction and an equal distance from Butte Valley in another, is now being actively developed by its owner, C. D. Hazzard of Quincy. The property, which has been in the possession of Hazzard for over 28 years, and has already cost him about $45,000 for development work, covers an area of ground approximately two miles in length and one mile in width.

San Bernardino County.—The Giant Ledge property at Ivanpah has been examined by the California & Arizona Copper Co. This is one of the old properties of the district. High-grade silver ore has been found in the Don Longo, shipments containing as much as 300 oz. per ton. The Nevada-California company has also found rich ore in its Carbonate mine.

Shasta County.—The Original Quartz Hill Mining Co. has brought suit in the United States Court in Sacramento against the Mammoth Copper Co. and its parent corporation, the United States Smelting, Refining & Mining Co., to recover $150,000 on account of an alleged breach of contract. The Mammoth, which had for eight years treated ore at the Kennett smelter from the Quartz Hill, as flux principally, shut down its work in the Quartz Hill in March 1914. The Quartz Hill claims the contract did not expire until October 15, 1916. The suit was brought Tuesday, October 12, or just three days before the claim would have been outlawed by the statute of limitation. The Estabrook gold dredges near Trinity Center has shut down on account of the high cost of material and labor.

Sierra County.—Application has been filed by G. W. Peer and H. L. Berkey of Scales, for 60 cu. ft. per second from Canyon creek, for hydraulic placer-mining purposes. The amount of water to be stored is 8212 cu. ft. Diversion works: Main canal 8.12 miles long. The project consists of seven storage reservoirs, final diversion to be from the lower reservoir of this group. Thomas and Leo Bessler are preparing to build a five-stamp mill on their property in Downieville. Power will be furnished by water from the Downieville Water Co.'s ditch. The pay-shoot at the Oro mine has widened and a tunnel has been driven to cut it at a lower level.

IDAHO

Coeur d'Alene.—The Sterling Silver Mining Co. reports that five men are employed at the mine. The lower tunnel has been extended 400 ft. and a drift on the No. 1 vein has been driven for 100 ft. showing gray copper. This will reach a point beneath the surface-showing in another 200 ft. The holdings of the company cover two silver-vein systems and both are to be explored during the winter. Lessees operating the Yankee Boy mine are shipping high-grade ore, some running 300 oz. silver per ton. The management of the Silver Dale and Big Hill, operating on the west fork of Big creek, states that development work will be resumed. A cross-cut tunnel is being driven to reach the orebody 700 ft. beneath the upper workings where 5 ft. of concentrating-ore was uncovered. The Liston property, now known as the First National, will soon be under active development. The lower cross-cut tunnel has been extended over 3000 ft. to reach the vein at a depth of 1000 feet.

Mullan.—Consolidation of three groups of mining claims located in the Mullan district, including the Lucky Boy, the Silver Star, and the Goldbar is to be effected, according to M. D. Needham of Wallace, one of the owners of the Lucky Boy. A crew will be put to work extending a tunnel to the Lucky Boy vein. Surveys are said to indicate that it will require 170 ft. of additional work to reach the Lucky Boy vein. This will give the workings a depth of 40 ft. "New faces of ore have been disclosed at several places near here," said Harry W. Ingalls, manager for the Copper King Mining & Smelting Co. "The Copper King has struck a body of ore 4 ft. wide. It was found on the new level, which is 200 ft. above the tunnel-level, and was reached by a cross-cut from the raise. No assay has been made, but the appearance of the ore suggests a content of 12% lead and 10 oz. silver per ton, and no zinc. The ground is not broken, as in places on the main tunnel-level. It is away from the fault and so solid that it is not necessary to use timber. About 200 ft. of work has been done on this level, the depth of which is 1500 ft." A contract has been awarded for sinking an additional 200 ft. of shaft in the Morning mine.

Wardner.—A find of large promise has been made on the property of the North Bunker Hill Mining Co., near here. The ore has been entered for 15 ft. without determining its extent. Its grade is low, running 6% lead and an ounce of silver per ton. According to reports the strike was made on the 500-ft. level. A cross-cut from the shaft was driven 300 ft. west, where it entered the vein, and the vein was followed by a drift for 130 ft. Neither wall is in sight at the face of the drift. The property is composed of three patented claims and two fractions lying between the Caledonia and the East Caledonia and not far from the property of the Bunker Hill & Sullivan Mining & Concentrating Co.

A large body of ore has been reported on the west hill of the Intermountain Mining Co.'s properties. The report to the company said that there are "three distinct and well-defined chimneys on the west hill, all connected by an ore-shoot of considerable dimensions". It is also stated that these bodies contain large amounts of silver-lead ore. The Caledonia Mining Co. is disbursing the regular quarterly dividend of $26,050. This is at the rate of a cent per share. The company has 1800 stockholders. The current disbursement will increase the total dividend payments to $4,141,950.

Wallace.—The shaft being sunk jointly by the Federal Mining & Smelting Co. and the Marsh Mines Consolidated from the Russell claim of the Marsh has attained a depth of 350 ft. from the tunnel-level. The shaft is following a vein which, it is averred, is the same as the Hecla east orebody. The Russell shaft has reached a horizon to which the Hecla is said to have raised on ore at the western part of the shoot. The shaft and the raise are reported to be 280 ft. apart. Whether the course of the orebody follows the horizon or parallels the fault-line is not known. If it parallels the fault-line it should be reached in 280 ft. of sinking, the angle of the fault being 45°, but if it follows the horizon it may be reached with any round of shots. The orebody is said to be 800 ft. long and to be rich in lead and silver. The Russell vein is nearly vertical at the bottom of the shaft, and its walls are well defined. The shaft is proceeding at the rate of 5 ft. per day.

The Nabob Consolidated Mining Co., in the Pine Creek district, is operating two shifts daily and expects to operate three in a few days. Four stopes are yielding ore and more are being prepared. The mill is producing a concentrate containing an average of 53% lead, but the tables produce 54% and the jigs 60%.

NEW MEXICO

Lordsburg.—The main shaft of the 85 mine, in the Virginia mining district, some three miles south-west of Lordsburg, is being sunk an additional 300 feet.

Red Rock.—It is reported that a deal has just been closed by which capitalists from Battle Creek, Michigan, will take over the fluorspar and plant holdings of the Great Eagle Mining Co., at Red Rock, about 30 miles north of Lordsburg. The purchasers will form a new company under the name of the Great Eagle Fluorspar Co. The consideration of the sale is said to have been $200,000, of which a considerable portion was cash. This property is believed to be one of the largest fluorspar mines in the entire South-West, having opened up a vein which, on the surface, was 5 ft. wide and has increased in depth to approximately 30 ft. wide. The development, mostly by tunnels and stopes, is reported to show, blocked out, 60,000 tons of ore valued at $30 per ton, or $1,800,000 total, above the lower tunnel-level. New equipment is being purchased and shipments are reported daily. It is announced that Mr. Wentworth, president of the Battle Creek Sanitarium, is president of the new company.

Boston Hill.—Rich gold and silver ore is reported at the Silver Spot mine. Assays show over an ounce of gold per ton and 13 oz. of silver, with 25% manganese. Efforts have been made, which it is reported have recently met with success, to secure adjustments in freight-rates on manganese ores which would permit resumption of shipping of manganese from Boston Hill.

Silver City.—The American Fluorspar Co., composed of Silver City business men, is reported to have started development work on a deposit of fluorspar situated near Derry, about 18 miles north of Hatch station on the Rincon branch of the Santa Fe railroad. J. W. Bible is the engineer in charge. The deposit is said to be a large one, and to contain high-grade spar.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

Scott Turner is in New York.

C. M. Eye has gone to Los Angeles.

C. Erb Wuensch is here from Colorado.

Thomas Cochran was at Salt Lake City recently.

Charles A. Mitke has been at Tyrone, New Mexico.

A. T. Thomson, of New York, is at Douglas, Arizona.

C. Colcock Jones has returned to Los Angeles from Mexico.

William D. Grannis, of Kingman, Arizona, was here last week.

Otto N. Ruger has left Sonora, Mexico, and will reside at Bisbee, Arizona.

Fred. E. Wood, of Denver, is examining shale deposits near Elko, Nevada.

Edwin T. Hodge is general manager of the Liberator mine in British Columbia.

Downie D. Muir, Jr., has returned to Salt Lake City from British Columbia.

S. M. Soupcoff has returned to Salt Lake City from British Columbia and Montana.

Harold Cogswell is with the Idaho Maryland Mines Co., at Grass Valley, California.

Stanley N. Graham is now professor of mining in Queens University, Kingston, Ontario.

William Wraith, of New York, was at Salt Lake City recently on his way to California.

Samuel W. Cohen, of Montreal, sailed on the 'Empress of France' on October 6 for Europe.

Robert D'Eichthal and **Albert Dellanger,** of Paris, France, have been visiting the mining districts of Utah.

Lloyd C. White has resigned as consulting engineer to the Simon Silver Lead Mines Co., of Mina, Nevada.

Edwin L. Forbes has accepted a position as auditor for the La Fe Mining Co. at Guadalupe, Zacatecas, Mexico.

William W. Adams, superintendent for the U. S. Smelting, Refining & Mining Co., at Grantsville, is in San Francisco.

J. I. McGeorge, formerly with the Silver King Coalition Mines, at Park City, Utah, has moved to Florence, Colorado.

Arthur B. Foote, manager for the North Star Gold Mines Co., at Grass Valley, is taking a short holiday in San Francisco.

Walter R. Vidler, superintendent for the Vanadium Corporation of America, at Page, Oklahoma, is at Long Beach, California.

L. Ibanez Velasco, assayer for the American Tin Corporation at Hill City, South Dakota, has moved to Sabinas, Coahuila, Mexico.

W. B. Plank has resigned from the U. S. Bureau of Mines to become instructor of mining engineering at Lafayette College, Easton, Pennsylvania.

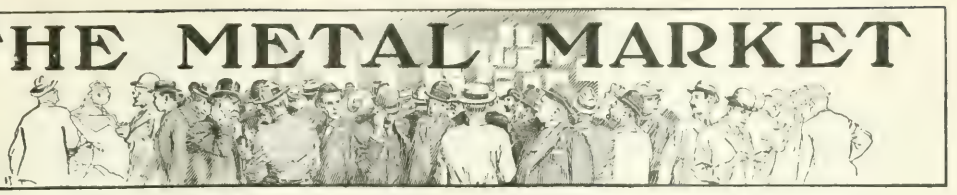
G. C. McElroy has been assigned as engineer in charge of U. S. Bureau of Mines rescue car No. 11, succeeding **R. V. Ageton,** who went to a similar position in Michigan.

Frederick Lyon, former managing director of the Mammoth Copper Co., and **A. P. Anderson,** mining engineer for the U. S. Smelting, Refining & Mining Co., visited the property at Kennett last week.

John Smeddle, recently at Guanajuato for the Cubo company, is on his way to New York by way of Zacatecas, and will then return to Mexico for the La Fe Mining Co., at Guadalupe, Zacatecas.

George L. Kaeding, having finished a complete plant for the driving of a long development tunnel for the Consolidated Cortez Silver Mines Co., in Nevada, has resigned as general superintendent and is leaving for Mexico.

THE METAL MARKET



METAL PRICES

San Francisco, October 19

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	18.75
Lead, pig, cents per pound	7.50—8.50
Platinum, pure, per ounce	$95
Platinum, 10% iridium, per ounce	$135
Quicksilver, per flask of 75 lb	$70
Spelter, cents per pound	9.00
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

October 18.—Copper is inactive and weak. Lead is quiet and steady. Zinc is lifeless but easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence
Oct.	12 Holiday		
"	13	87.00	56.25
"	14	85.62	55.25
"	15	82.37	53.62
"	16	81.25	53.00
"	17 Sunday		
"	18	79.25	52.12

Average week ending		Cents	Pence
Sept.	6	93.27	58.90
"	13	93.96	59.15
"	20	94.31	60.08
"	27	93.52	59.66
Oct.	4	91.65	58.98
"	11	86.77	55.66
"	18	83.10	54.05

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	93.66
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		
Oct.	12 Holiday	
"	13	17.50
"	14	17.25
"	15	17.00
"	16	17.00
"	17 Sunday	
"	18	17.00

Average week ending		
Sept.	6	19.00
"	13	18.75
"	20	18.75
"	27	18.70
Oct.	4	18.50
"	11	17.85
"	18	17.15

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	18.75
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		
Oct.	12 Holiday	
"	13	7.50
"	14	7.50
"	15	7.50
"	16	7.50
"	17 Sunday	
"	18	7.50

Average week ending		
Sept.	6	8.55
"	13	8.29
"	20	8.06
"	27	7.85
Oct	4	7.54
"	11	7.50
"	18	7.50

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	8.08
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	44.43
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		
Oct.	12 Holiday	
"	13	7.50
"	14	7.50
"	15	7.35
"	16	7.35
"	17 Sunday	
"	18	7.35

Average week ending		
Sept.	6	8.29
"	13	7.78
"	20	7.83
"	27	7.73
Oct.	4	7.66
"	11	7.55
"	18	7.41

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	7.84
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		
Sept.	21	75.00
"	28	75.00
Oct.	5	75.00
"	11	75.00
"	19	70.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	75.00
Apr.	105.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

GOLD SHIPMENTS

'The Boston News Bureau' publishes the following from London: "There is to be no change in the policy of the British government regarding export of gold to New York, and large shipments of yellow metal will continue indefinitely. Volume will be limited only by the output of the mines, as it is understood the major part of all gold arriving in London will be sold for American account. Reports of gold arrivals in New York appearing in the financial columns of the London newspapers are now taken as a matter of course.

"None of the gold recently shipped has been on the Government's account. Shipments to cover the British share of the Anglo-French loan were completed long ago. All the gold now going is on private account, and the export is not merely permitted, but promoted by the British as tending to restore healthy financial relations. Every shipment of gold means that bills are being paid in that metal in New York as the easiest and cheapest way of settlement. A large part of the commodities represented by those payments are goods of British manufacture. The British Treasury sees no advantage in having the gold held in Great Britain. The reserves in the Bank of England cannot be augmented. The English banks are amply protected. With London as the world's immediate gold reservoir, the British government is always in a position to regulate its outflow.

"Just now its interest is in having a good deal of gold flow into the vaults of the Federal Reserve Board. British and American finance is so closely interwoven that the British treasury takes almost as great an interest in our financial structure and transactions as it does in the Bank of England. The theory is that the supply of British gold to the Federal Reserve Board is a sustaining influence that will react favorably, not merely to British interests but will help to keep our Federal banking system in a favorable position as regards world finance.

"Mention has been made recently of the decrease in the world's supply of gold, which it is estimated will this year fall below £70,000,000, a 27% decrease from the world output five years ago, when it was over £96,000,000," and Samuel Montagu & Co. state that the gold imports and exports of the United Kingdom for August were:

	Imports	Exports
Russia	£ 715,530	....
Sweden	40,400	....
Netherlands	6,636	£ 530
France	4,200	1,320
Switzerland	....	137,500
West Africa	55,941	3,443
United States of America	....	3,346,000
Egypt	....	89,250
Rhodesia	195,488	....
Transvaal	2,624,354	....
British India	48,500	1,118,548
Straits Settlements	8,732	....
New Zealand	2,741	....
Other countries	541	12,596
Total	£3,703,063	£4,709,187

MONEY AND EXCHANGE

Foreign quotations on October 19 are as follows:

Sterling, dollars:	Cable	3 43½
	Demand	3 44½
Francs, cents:	Cable	6 44
	Demand	6 45
Lire, cents:	Demand	3 85
Marks, cents		1 51

Eastern Metal Market

New York, October 13.

Extreme dullness characterizes all the markets. That the worst has passed is a quite general belief, particularly in some well-informed quarters. The observance of Tuesday, October 12, Columbus Day, as a holiday was a damper on business.

Copper buying is exceedingly light, though it has increased a little with a further fall in values.

The tin market is very quiet with consumers uninterested and dealers only spasmodic buyers.

The lead market is the firmest of all, but is without animation. Prices are stationary.

Quotations for zinc are lower and demand is insignificant.

Antimony is quiet and unchanged.

IRON AND STEEL

The expectation of lower prices still controls the steel market, but the readjustment is slow-paced, irregular, and confused, says 'The Iron Age'. This week signs of changed conditions have appeared in wire-products, tin-plate, and some other lines which previously had escaped the effects of the business reaction. Buyers of nails who have readily paid independent makers' prices are now holding off and some cancellations are reported. The weaker tendency in tin-plate comes with the passing of demand from makers of perishable-food containers. The largest independent producers, with three months business on their books, are generally maintaining their position.

Steel-ingot production in September was substantially the same as in August—2,999,551 tons by 30 companies, which made 85% of the total in 1919, as against 3,000,432 tons in August. For the entire country the September output was thus about 3,524,000 tons, or at a yearly rate of over 42,000,000 tons.

The re-selling of pig-iron has increased to such an extent as to dominate the market in leading centres, with almost no buying from furnaces. Some blast-furnaces may stop in the event of lower pig-iron prices with no accompanying decline in coke. The persistently high market for coke, $17 to $18 being paid on spot shipment, makes a serious problem for merchant blast-furnaces.

COPPER

Conditions in this market are by no means improved. Prices, forced down by dealers and some small producers and perhaps even by some large ones, have fallen to lower levels. Just what the market is, it is difficult to definitely say. One representative of a large producer placed the range for electrolytic copper at 17 to 18c., New York. It can definitely be said that small lots of electrolytic have changed hands at 17.50c., which we quote as the market for both Lake and electrolytic. It is possible that as low as 17 to 17.37½c. could be done, but there has been no fair test on a large scale in the absence of demand by large consumers. They are evidently waiting to see what the bottom will be as a result of a nation-wide lowering of commodities in general. There is a note of optimism, however, as to the future and the belief of a radical change for the better by November 15.

TIN

The week has again been a quiet and featureless one. There is almost no demand. Consumers are uninterested and buying by dealers has again fallen off owing to the unsuccessful attempt of one dealer a week ago to revive the market. This was referred to last week. Even on the New York Metal Exchange business has been light. There was a sale on October 5 of 25 tons of spot Straits under the hammer at 42c. On October 7 there were sales of 75 tons of Straits for October-November shipment in three lots of 25 tons each at 43.25, 43.37½, and 43.50c., respectively. The quotation for spot Straits on Monday was 41.50c., New York, and in London it was £265 15s. and future standard £269, all declines from a week ago. Because of the holiday on Tuesday, yesterday, and the lower London market, no business was expected until today. Arrivals thus far this month have been 1130 tons with 5065 tons afloat.

LEAD

There is very little to be said about the market, which has undergone few changes. More metal is being offered, both foreign and domestic, with sellers seeking orders but buyers very scarce. Imported lead is available at around 7.50c., New York, or seaboard, which establishes the Eastern market; the quotation of the leading interest remains at 7.75c., New York, but it is not selling. Domestic lead has sold for prompt shipment from the West at a slight concession from the price of the American Smelting & Refining Co., or equivalent to 7.70c., delivered at some Eastern points. The outside market is quoted at 7.35c., St. Louis, while that of the Trust is unchanged at 7.50c., St. Louis.

ZINC

There is very little demand and producers are not quoting and are selling only to favored consumers for hand-to-mouth needs. Prime Western, as established by imported metal re-shipped from Europe, is quoted at 7.50c., New York, while domestic zinc is quoted at 7.35 to 7.40c., St. Louis. An inquiry for a substantial amount for delivery in the first quarter at 7.40c. offered, St. Louis, was frowned upon by sellers. A feeling of optimism is current, however, that the bottom has been reached and that some will sell higher inside of two months. While imported metal is a factor in this market it is not expected to increase. Estimates place the total amount contracted for for importation at about 7000 to 7500 tons.

ANTIMONY

The market is quiet and unchanged at 7c., New York, duty paid, for wholesale lots for early delivery.

ALUMINUM

The market is unchanged. Virgin metal, 98 to 99% pure, is held by the leading producer at 34.90c., producer's plant, while other sellers handling foreign metal largely ask 29 to 30c., New York.

ORES

Tungsten: The market is without developments of any significance and demand is very small. Quotations are largely nominal and unchanged at $4.50 up per unit, depending on the ore, its quality, source, and delivery. Prices for ferro-tungsten are unchanged. High-speed steel is down to $1.10 per pound.

Molybdenum: Quotations are unchanged in a very dull market at around 70c. per pound of MoS_2 in regular concentrates.

Manganese: About 2000 tons of Indian high-grade ore has been sold at around 55c. per unit, seaboard, the lowest in some months.

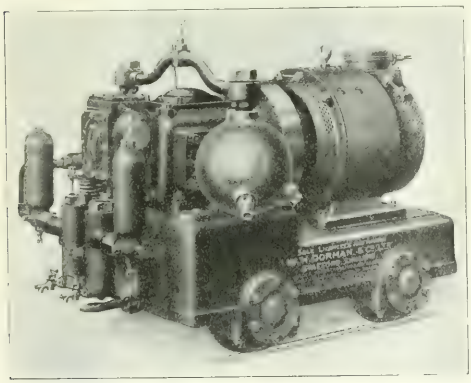
Manganese-Iron Alloys: There is no demand for ferro-manganese and prices are unchanged on a basis of $170, seaboard, for foreign and domestic alloy. Production continues heavy, having been 27,686 tons in September, according to the blast-furnace reports of 'The Iron Age'. Re-sale alloy, at least, could be purchased at a concession, it is believed. The spiegeleisen market is quiet but steady at $80 and $82.50, furnace, for the low and high-grade product, respectively.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

'SONIC' TRANSMISSION OF POWER

There are at present five methods in commercial use for the transmission of power, namely, steam, direct mechanical, electric, compressed air, and hydraulic. 'Wave-transmission' and 'sonic transmission' are alternative names used to describe a sixth method in which are employed wave-motions or pulsations set up in an enclosed column of liquid. The liquid (usually water) is contained in a pipe connecting the apparatus generating the wave-motions to the machinery which applies them to useful work. Although apparently similar to hydraulic transmission, the underlying principle of 'wave-transmission' is totally and absolutely distinct. In hydraulics a continuous flow of liquid or motion of the liquid column as a whole invariably occurs, whereas in 'wave-transmission' there need be no direct or continuous flow, the particles of the liquid merely pulsating backward and forward about a mean position.



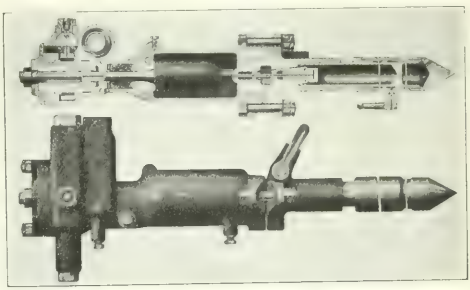
Wave-Generator, Electrically Driven

Water is compressible. Owing to the degree of its compressibility being very small compared to many materials in daily use, the idea that water was incompressible came to be accepted even by engineers. For the first time in the history of mechanics advantage is taken in 'wave-transmission' of the elasticity of water (and also of oil and other fluids) to transmit energy.

What occurs in 'wave-transmission' can be illustrated by simple analogy. In the ordinary speaking-tube, pulsations set up in the contained air by the vibration of the speaker's vocal cords travel in the form of sound waves to the far end, where their energy is utilized in reproducing the vibrations in the ear of the listener. The column of air in the tube does not flow through the tube, but the particles merely subjected to small movements to and fro as the sound-waves pass along. Similarly in 'wave-power transmission' the pressure impulses set up by the wave-power generator travel through the column of fluid contained in a metal pipe which connects the wave-power generator to the wave-power motor. There is no continuous flow, the fluid progressively moves forward and backward about mean positions. The wave thus travels through the column of liquid and gives up its energy to the motor at the far end. The motor is a simple mechanism for converting the waves of energy into any desired mechanical action.

Taking the simplest form of 'wave-transmission', imagine two cylinders fitted with plungers, the cylinders on the underside of the plungers being connected together by a long pipe completely filled with water. If one of the plungers is moved rapidly up and down it will set up at each downward stroke waves of compressed water, which traveling along the pipe at the speed of sound (about 4800 ft. per second) will exert their energy on the plunger at the far end, and if this be suitably loaded, a simple reciprocating motion will be produced in exact synchronism with the reciprocations of the first plunger.

Wave-transmission equipments are inexpensive to manufacure, simple in construction, and practically 'fool-proof' in operation. They consist of:



Wave-Power Drill

Wave Generator: One or more metal cylinders each fitted with a piston connected by a crank-shaft to any type of high-speed prime mover such as an ordinary steam or internal-combustion engine or electric motor.

Wave Motor: One or more metal cylinders each fitted with a piston, designed to receive the power-wave at the intake end. The other end of the piston is suitably connected to the tool or other mechanism desired to be operated. The simplest application is found in such appliances as rock-drills and riveting-hammers in which the piston is used as a floating hammer and strikes directly on the shank-end of the drill-steel or rivet-snap.

'Wave-Transmission' Pipe-Line: Ordinary rigid or suitable flexible piping is used to contain the liquid which extends from the wave generator to the motor, and is referred to as 'the liquid column'. Various kinds of fluid may be used, from water to heavy oil. The highest transmission efficiency is, however, obtained through water.

In many ways electricity offers an excellent analogy to explain both 'wave-transmission' and hydraulics, ordinary hydraulics being represented by the continuous current and

'wave-transmission' by the alternating current systems. From the scientific and practical point of view one of the most interesting facts about 'wave-transmission' is this similarity in many features to alternating-current electrical transmission. The points of resemblance are not mere coincidences. They go to prove the important fact that this purely physical method of transmitting energy is closely allied and is for all practical purposes a sister method, to the alternating-current electrical system. Anyone with a knowledge of electricity will find it easy to understand 'wave-transmission'. The laws and formulae of wave and of electrical transmission coincide to the extent that they are nearly interchangeable. Most of the phenomena of electricity have their parallel in 'wave-transmission'. For instance there are direct equivalents for volts, amperes, frequencies, angle of phase, induction, capacity, resistance, condensers, transformers, and single-phase or poly-phase systems. In both systems there are used generators, rotary and reciprocating motors, and transmission lines.

G. Constantinesco is the inventor and W. H. Dorman & Co., Ltd., Stafford, England, is manufacturing a complete line of tools to take the place of compressed-air systems. The Dorman company claims simplicity, portability, low initial cost, and safety as leading features of their equipment and estimate the comparative efficiency as follows:

	Compressed air	Wave-power transmission
Mechanical efficiency over all	10%	50%
Cost of maintenance per annum in proportion to the original cost of tools	100%	33%
Capital cost of plant, including prime mover	100%	50%
Power required to be put into the system to procure 1 hp. at the working-face	10 hp.	2 hp.

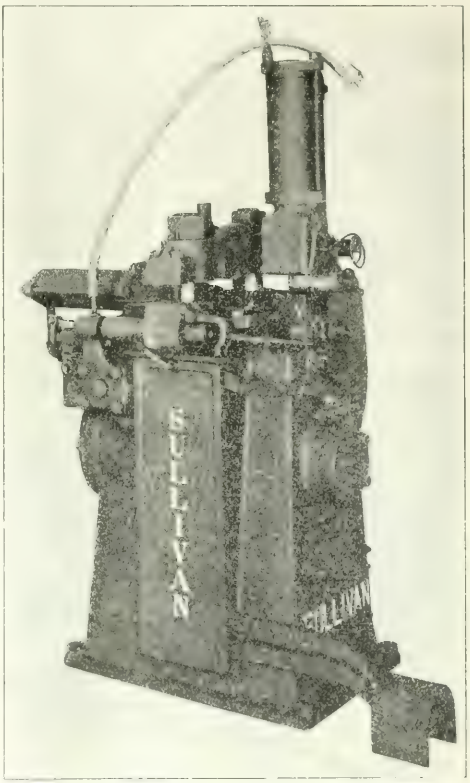
This method of transmission was used during the War for 'C. C. gears' for automatic firing of aeroplane guns and more than 30,000 equipments were made. Generators are constructed in sizes from 10 hp. up and for frequencies up to 50 cycles per second.

SULLIVAN LIGHT MODEL DRILL SHARPENING MACHINE

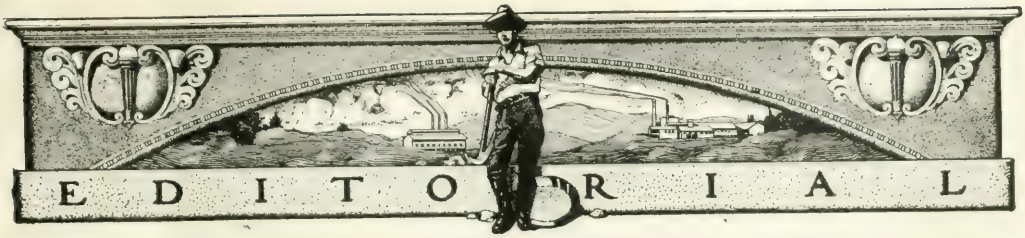
The success attained by the adaptation of the all-hammer process in sharpening and shanking drill-steel as incorporated in the Sullivan drill-sharpening machine, has recently induced the manufacturers to design a new-model sharpener, embodying the same principles but of smaller and lighter construction, suitable for making and sharpening bits on the steel used in the standard sizes of hammer drills. This machine, which is shown in the accompanying illustration, is known as the Sullivan Class B sharpener, and is designed for handling solid or hollow steel of any section up to 1¼ in. diameter, and to make bits up to a maximum gauge of 2½ in.

The Class B sharpener weighs 1500 lb. as compared with 4000 lb. for the larger machine, occupies a floor area of 4 by 2½ ft., and stands 5 ft. high. The essential features of the Class B sharpener consist of a horizontal hammer cylinder and piston, operating a dolly for upsetting, and a vertical cylinder and piston operating dies for swedging the drill-bits or shanks. For upsetting, the steel is clamped in steel dies mounted in the lower, or stationary, and upper, or movable, jaws of a yoke or vise operated by a horizontal air-cylinder situated in the base of the machine. The two hammer cylinders are modified Sullivan DR-6 drills, equipped with floating hammer-pistons, and a valve motion which imparts a blow of great strength and liveliness to the dies and dollies. Air is admitted to the horizontal hammers by the same valve mechanism which controls the vise. In order to secure the advantages of the floating hammer-piston in the vertical member of the sharpener a novel construction has been employed. When air is admitted to the vertical hammer-cylinder, the pressure acts on top of an annular piston fitted in the lower cylinder-head, which forces the upper vertical swedging-die down against the steel and holds it in this position in the same manner as the hand blacksmith, or his assistant, holds the flatter or swage in hand forging. The vertical hammer then strikes against the die, drawing out the corners of the steel to proper gauge and thickness.

In making or re-sharpening bits the steel is shifted from one hammer to the other, being alternately upset and



swedged until of the proper gauge and shape and the wings, corners, and the cutting edge is properly drawn out to be uniform, and of the right thickness and angle. With a little practice perfect bits of the usual shape are made in one heat, in a minute or less, on either solid or hollow steel. Ordinary dull bits may be sharpened in from 20 to 25 seconds. In making shanks one heat is sufficient to forge those that require upsetting only, or swedging only, and two heats are necessary for shanks requiring both upsetting and swedging, such as the lugged or ear shanks used on Sullivan DX-61 and DR-6 drills. The Class B sharpener is fitted with a number of improved devices, which enable ordinary and special operations on the drill-steel to be performed with a greater measure of economy and time, and convenience for the operator. As it has been found that a drill-steel punch for opening the hole in hollow-steel bits and shanks is a practical necessity, such a punch has been built into the new machine. The double-taper bits which are doing so much to reduce the cost of mining can be accurately formed on the new Sullivan sharpener by means of an adjustable gauge-plate and dies, which are operated by action of the clamping-yoke or vise. Sixteen different gauges can be provided by means of the gauge-plate which is controlled by a key.



T. A. RICKARD, - - - - Editor

THERE are aids more urgent than the bonus on gold that the Californian miner ought to have. As soon as the recent rains started to swell the mountain streams the State Railroad Commission gave permission to the 'movies' to run longer hours and to the merchants to light their show-windows and electric signs more freely, but left the mining industry 20% short of its normal power.

STATISTICS prepared by the U. S. Bureau of Immigration indicate a net decrease, during the year ended June 30, 1920, in the number of aliens working in the mines of this country, of more than 2000 as a result of emigration. While 3080 immigrants entered the mining industry, 5279 miners departed for their native lands. The iron and steel mills, on the other hand, gained 1515 alien recruits and lost only 174.

FIGHTING FIRES in mines is the subject of an article in this issue by Mr. H. J. Rahilly. He holds the appointment of mine-fire superintendent to the Anaconda Copper Mining Company and is therefore in a position to write with authority. We take the opportunity to compliment Mr. John L. Boardman, the editor of 'The Anode', which is the organ of the Bureau of Safety of that company, on his publication, in which we often find something to interest us.

IDAHO has reason to be proud of the fact that both the candidates for the State Mine Inspectorship are fully qualified engineers, and not, as has happened heretofore, farmers, sheep-herders, or cheap politicians. The Republican candidate, Mr. Stewart Campbell, is a graduate of the mining school in the University of Idaho and served with the engineer corps of the Army in the War. The Democratic candidate, Mr. William M. Snow, is likewise a mining engineer and a graduate of the State School of Mines; he has practised successfully in the Coeur d'Alene. Both are good men, and whichever is elected the State of Idaho will have an excellent Inspector of Mines.

DIVERSION of the traffic in copper from the railroad to the steamship is one result of the increased transcontinental freight-rates. It is announced that the Anaconda company henceforth will transport its copper from Great Falls by way of Seattle, thence by sea, through the Panama Canal, to New York. Overland the railroad tariff is $22 per ton; the freight by rail to Seattle is $7.75 and from there to New York by steamship it is $8, making a total of $15.75, or a saving by the sea-route of $6.25 per ton. The first shipment of 1000 tons was loaded on the 'Hannawa' of the Luckenbach Steamship Company at Seattle on October 16. Other smelting companies are likely to follow suit.

WE note that the San Francisco Chamber of Commerce advises the people of California to vote against the initiative measure to amend the Alien Land Law of 1913, as against the Japanese, because it believes that the real problem is "in the last analysis, one of immigration" and it considers that the measure contains "unnecessarily harsh provisions concerning the guardianship of the children of residents not eligible to citizenship". The immigration of those "politically ineligible to citizenship" should be forbidden by the Federal government, either by treaty or legislation, and preferably by treaty. The initiative measure is considered likely "to stir a spirit of irritation and hostility", calculated to prove "a hindrance to the Federal government in the attainment of a final solution of the question of immigration". We concur.

DECISION in the litigation between the Utah Apex and the Utah Consolidated companies over lead-silver deposits at Bingham has been made by Judge Tillman D. Johnson of the U. S. District Court of Utah. The opinion sustains the contentions of the Utah Apex Mining Company. Briefly, it determines that the ore deposits are associated with fissure-veins in the limestone and that the limestone beds themselves do not constitute 'lodes' within the meaning of the Federal mining law. We shall give the text of the decision in a later issue. The chief bearing of the decision upon controversies in other districts arises from the fact that the Court refuses to recognize the outcrop of the mineralized limestone as the apex of a lode in a locality where the distribution of the ore is associated with fissures that cross the beds at a high angle.

WE note the organization of a Mining and Metallurgical Society on the Kolar goldfield, in India. The first president is Mr. C. F. Heathcote, the resident manager of the Champion Reef mine and an engineer well fitted to preside over a gathering of technicians. At

the first meeting he said: "We do not want to flood the profession with papers on Kolar practice, but we do want it to be known that we are leading in deep mining, in the treatment of our ore, and in measures for the health, safety, and welfare of our workmen." Among the local problems on which information would be welcome is the mitigation of the effects of 'rock-bursts' or 'air-blasts', the consequence of stopes so extensive as to cause excessive pressure on the hanging wall, as in the Lake Superior copper region. Another is the alleviation of the heat incidental to deep mining, that is, the technique of ventilation. As to the mining of the ore and the treatment of it, we believe our American engineers have not much to learn from their friends in India, but concerning "the health, safety, and welfare" of workmen there is much yet to be said and done. We hope the new society will be a means for stimulating improvements in this branch of mine management.

ALTHOUGH so many of our people fight shy of the League of Nations, they approve of plans for promoting international co-operation in finance and commerce. At Brussels an International Chamber of Commerce is now firmly established. We are told that "for years, enlightened business men everywhere looked forward to the day when there would be set up in the world an institution which would serve to bring the nations together, and facilitate settlements of foreign trade problems. They had recognized that personal friendships between business men and bankers of the different nations go a long way toward minimizing misunderstandings and prejudices." So says the bulletin of the Chamber of Commerce of the United States. It is true, and it is pleasant to record, that business brings men together and establishes mutual good feeling; but is it not sad to recognize that the interest in money affairs will promote co-operation and lead to the organization of leagues for expediting business, whereas the bigger and vastly more important purpose of promoting international peace in political affairs is relegated to one side. "The necessity for co-operation in matters of world trade", says the bulletin we quote, "is realized as never before". One need not be a cynic to note that there is more care to protect the money of the worthy bankers and their friends than to safeguard the lives and happiness of the helpless millions whose fate it is to be sacrificed in war.

LIQUID OXYGEN is of growing importance as an explosive. Not long ago Mr. George S. Rice, of the U. S. Bureau of Mines, discussed the subject in San Francisco before the local section of the Institute. He has published sundry data recently. Among other facts, he states that one company, the Deutsche Oxhydric, of Surth, near Cologne, has furnished, since the Armistice, 64 plants for making liquid oxygen on the German coal-fields. These plants have a total capacity of 1820 litres of liquid oxygen per hour. At the metal mines of Germany there have been added, since the Armistice, 46 plants with a total capacity of 1407 litres, and at the potash and salt mines there have been added 14 plants with a total capacity of 450 litres per hour. Assuming that only 25% of this aggregate capacity is utilized and that the plants are operated for only nine hours daily for 300 days in the year, this additional production of liquid oxygen would be equivalent to 8,000,000 pounds of dynamite per annum. Another interesting development is the design and construction of small portable plants for making three to five litres of liquid oxygen per hour; such plants are placed on trucks and are made easily available for various engineering activities. Liquid oxygen is an explosive that generates no injurious gases; on the contrary, it improves the air of mine-workings. For this reason we expect its use to expand in this country.

IN this issue we publish the third and last of the articles by Mr. Ingalls. We feel certain that they will have been read with keen interest. He brings into relief the gain that has come to brawn from the successful use of brain. The story of copper mining during the last decade is a case in point. If it were not for the ingenuity and inventiveness of the mining engineer and the metallurgist many of the biggest mines would not exist as a source of wages to thousands of laborers. During recent years their wages were scaled in proportion to the selling price of copper, which, in turn, was supposed to measure the profit won by the employing companies. For a time, in 1915 and 1916, the efficiency of labor did not suffer; we remember being told cheerfully that the increase in wages in Arizona, from $3.50 to $5.00, did not cause an increase in the cost of producing the copper. Everybody was happy. This did not last long. The workers slacked; some of them took a holiday and thereby caused disorganization; others felt the relaxing effect of prosperity; it is certain that higher wages and shorter hours diminished the output per man per shift. Various classes of workers fared unequally during the period of expansion due to the exigencies of war; the metal miner fared best. Theoretically it might be desirable, as Mr. Ingalls suggests, if corporations earning an excessive profit would pay a bonus to their employees, but would the employees of the successful corporation deserve more than those employed by its competitors? One may say also that the stockholders in one corporation are not as individuals more deserving than the holders of stock in the less successful enterprises. Even if one conclude, with Mr. Ingalls, that the profit is due to managerial excellence, that is, to the superior intelligence of a few directing minds, one must face the fact that much of the success of mining is due to luck. Who is to decide how much is due to luck and how much to skill? Any scheme of economics that tries to correct the irregularities of life on the basis of desert, of what various people deserve, is stultified at the start. The greatly successful industrial enterprises of this country are due first to natural resources, next to the development of technicians competent to exploit them efficiently, and last to an adequate supply of labor. Each is essential. The technician, or the engineer, using the word in its broadest sense, is the connecting link; his is the mind that applies muscle to mat-

ter, labor to material, for the purpose of turning the matter and material to fruitful use for the benefit of mankind. Only one man in sixteen is capable of directing his own labor.

Our National Responsibility

As Mr. Elihu Root says: "A large majority of the American people earnestly wish for an organization among civilized nations, through which the nations shall co-operate to prevent future wars, and that the United States shall do her full share in that organization". The wishes of this majority have been frustrated by throwing the issue into party politics and thereby creating a prejudice that now makes it difficult to consider the subject judiciously. Most of us will place the blame on both sides, on the President for disregarding the treaty-making power of the Senate and on the group of Senators who so obviously determined to disregard the welfare of humanity in their keen desire to humiliate the President. The consequence has been an entire failure in constructive legislation looking toward a League of Nations and a perversion of the co-operative spirit that marked our effort in the War. The fine emotions of that heroic period have been allowed to subside and an Americanism has been invented that has "no foundation whatever in any of the authentic traditions of the Government". We who went forth nobly to keep the world free for democracy are now bidden to let the world, the old world of Europe, stew in its own acrid juice. It is none of our business, say the politicians; we have done enough, let us attend to our own affairs; if we allow ourselves to be tied by this Covenant we shall have to send our young men to fight in quarrels that do not concern us, we shall become entangled in all sorts of wars for which we are not in the least responsible.

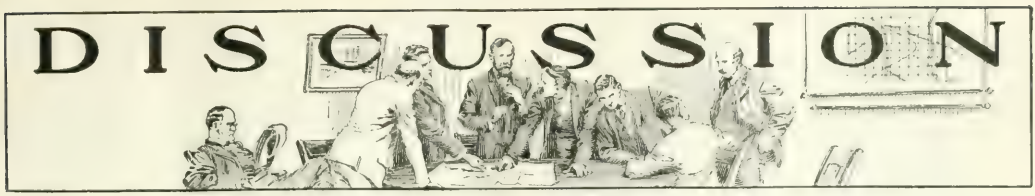
At the bottom of much of the opposition to our underwriting the Covenant is an earnest feeling of pacifism and a desire to keep out of more wars. The people of the United States desire peace intensely and they hate the idea of becoming mixed in the traditional enmities that are still disturbing Europe. If we could avoid war by political detachment from the rest of the world, we would be justified from the point of view of enlightened self-interest in keeping aloof. A man's duty to his own household comes first; a Government's fundamental duty is to protect the welfare of the people it represents. The pose of minding one's own business is not heroic, but it may be called shrewd. Unfortunately the conditions of the world in which we live render any such detachment or isolation entirely impracticable. We are not living in the days of Washington and Hamilton; they would smile at those who quote them in regard to "European entanglements" because they would be the first to recognize the changes that have taken place in political geography. There is more intercourse today between America and Europe than there was a hundred years ago between North Carolina and South Carolina. The Atlantic is less of a barrier today than the English Channel in Napoleon's time. It should not be necessary to emphasize this point; the incidents of the late war have proved in most dramatic fashion to what extent time and space have been contracted in consequence of modern inventions, and they suggest how much the development of aerial attack may further shrivel the intervals of space upon which in Washington's day it was possible to count as a factor of political separation and national detachment. Since the Republic was founded we have been drawn into both of the two general European wars, despite every effort to keep out of them. The opponents of Mr. Wilson say rightly that he spoiled the national purpose, as Mr. Root says, of co-operating for the prevention of future wars, by playing a lone hand, in despite of the Senate; but are not Mr. Wilson's opponents doing their best to drive our country into exactly the same kind of blunder, by urging the Nation to play a lone hand in world affairs and to ignore the partners with whom but lately we played a winning game against our common enemy in the common interest, as we believe, of mankind? Shall we wash our hands of the War with our purpose half-fulfilled? Today we are economically the richest and most resourceful nation in the world; shall we shirk our responsibility as a trustee of the common civilization to which we belong? Humanity is in travail, it is making a painful effort to emerge from the barbarism of war, the inheritance of the jungle; shall we stand by as a selfish spectator? Would Washington or Lincoln approve it? No answer is needed; we dishonor their names by the mere supposition. All this talk of surrendering sovereignty to the League supposes that an association is possible without restriction of individual freedom; it is the freedom to make war and the liberty to plunge millions into death and destruction that we want to limit. We have entered into numerous arbitration treaties, each one of which has meant some parting with our liberty of action. Sovereignty is lost only when liberty of action is taken from a country against its will. The State cannot function without limiting the liberty of the individual citizen, yet he is not conscious of losing his essential freedom to do what is right and proper. The whole structure of civilized life is based upon the surrender of self-assertion for the sake of the common good. We have taken from the individual man the right, which he brought with him from savagery, to attack his fellow. We must take from a nation the similar right, also a belated barbarism, to attack its neighbor. For nations as for individuals we substitute a court of appeal, with power to arbitrate, adjudicate, and if all else fail then to outlaw the offender. The swashbuckler and the bandit among nations must be suppressed; the double standard of conduct as between individuals and as between nations must be rendered obsolete. That is the purpose of the League of Nations. Surely it is a noble purpose and worthy of our support as the chief exponent of the democratic idea. For that we fought but lately with no inconsiderable enthusiasm. We esteemed our young men to have died for a noble cause. We talk now about erecting memorials to them in the shape of monoliths, towers, and sacred fanes all over our broad land. The sentiment is excellent, but somewhat hollow. To

those who have stood on the desolate battlefields of Europe and seen with their own eyes the sacred ground upon which millions of men died for the sake, as they believed, of putting an end to wars, it seems but a mockery to erect structures of granite and marble. The only memorial worthy of the unreturning brave is the consummation of the idea for which they died: a league of the nations for the enforcement of peace.

The Ownership of Mine-Water

The hearing of the suit of the Snake Creek Mining & Tunnel Company v. the Midway Irrigation Company, on appeal from the decision of Judge Tillman D. Johnson of the U. S. Federal Court for the District of Utah has been set for December next, when the case will be argued before the U. S. Circuit Court of Appeals at St. Louis. To the mining industry the final outcome of the suit is sufficiently important to warrant discussion at this time. The Snake Creek tunnel, which, by the way, is really an adit, was projected jointly by the Judge Mining & Smelting Company, owner of various mines and of a large area of mining property in the Park City district, and by the group associated with Mr. Jesse Knight of Provo; but the Judge company is now sole owner by deed of conveyance of all property, water, power contracts, and other assets formerly owned by the Snake Creek Mining & Tunnel Company. The tunnel has been driven 14,500 feet from the portal on Snake creek toward the Daly Judge mine, the purpose being threefold: to afford drainage of the Park City properties at a lower level, to explore the territory traversed, and ultimately to provide a means for cheaper haulage. Two 18-inch tracks or a single track of 36-inch gauge can be accommodated. The feature of the project that is the cause of controversy is the development of an unexpectedly large flow of water, the present stream being 20 second-feet with a probable increase to 30 feet by the time the tunnel has been completed. The ownership of this water is an important asset to the mining company, on account of its value as a source of hydro-electric energy; in fact, one of the factors determining the construction of the Judge electrolytic-zinc plant near Park City was the possession of favorable power-contracts, which could not have been obtained except for the title to the Snake Creek tunnel-water. The Midway Irrigation Company had certain water-rights that it believed were affected detrimentally by the driving of the tunnel; the purpose of the suit is to quiet title to any interest in the water developed by the tunnel. There is an established principle of common law providing that percolating water belongs to the soil: the crux of the question is the meaning of the word 'percolating'. The interpretation for which the plaintiff contends presumes that water issuing from a tunnel or adit belongs to the owner of the ground through which it is driven, regardless of its draining any spring or other water-channel, unless the owner of the ground in which such channel exists can prove beyond reasonable doubt that the water claimed to have been diverted comes from known channels with a definite direction of flow leading to streams whose water is owned by the adverse claimant. When the suit was originally tried, the Judge company merely presented evidence to establish ownership of the ground traversed by the tunnel and rested its case there. The defendant company thereupon presented evidence to establish its ownership to the water, the conduct of the trial being similar to suits involving apex controversies in that elaborate exhibits and expert testimony played a prominent part. One of the plaintiff's exhibits was a hydrograph of the flow from the tunnel showing the periodic fluctuation during successive years. However, it appeared that the periods of maximum flow post-dated the peak-flow of the surficial streams by from two to three months. This, it was argued, proved that in reaching the tunnel the water from the surface must have passed through minute cracks or capillary and sub-capillary openings in the rock rather than through open channels of definite direction. Otherwise a much briefer period must have elapsed between the time of greatest surficial flow and the maximum flow in the tunnel. Sundry other arguments based on the technical testimony of scientists were advanced and the Court held in its decision that the plaintiff had proved the water to be 'percolating'.

Litigation of a similar character was discussed in our columns by Messrs. G. A. Duncan and R. T. Walker two years ago. The dispute was between two mining companies operating in the Eldorado Canyon district in Nevada. It appears that the defendant company, after a particularly dry season, sank a shaft at a point where one of the strongest faults in the district crossed a deep gulch. Water in considerable quantity was found and was pumped to the company's mill a mile and a half distant. The plaintiff, whose property was situated farther down the same gulch, found that its supply of water began to dwindle at about this time, although at the trial it was established that this decrease was noticed some weeks before the other company began to pump from its 'water shaft', or well. At any rate, operations at the plaintiff's property had to be suspended entirely owing to the inability of its mine to supply sufficient water to keep the cyanide plant in operation. At the trial it was shown that the total amount of water pumped by the defendant was only a small proportion of the decrease noted by the plaintiff, and the plaintiff was unable to establish any significant relationship between the lessening of its own water-supply and the pumping from the defendant's new water-shaft. The decision of the Court, however, did not undertake to pass upon the question as to whether water "flowing along a fault-plane entirely enclosed in rock, is or is not 'percolating' water". Mr. Walker pertinently suggested the complications that might follow an attempt to narrow the scope of the term 'percolating water', that is, to recognize a fault, fracture-zone, bedding-plane, or other vague passage-way as constituting a 'well-defined channel'. It is evident that there is enough scope for mining litigation without recognizing obscure passage-ways as definite water-channels. Were such a precedent established a company would risk some legal entanglement every time it started to sink a shaft or drive an adit.



Engineering Education

The Editor:

Sir—In your issue of August 14 you discuss engineering education and invite further discussion. I believe that a four-year course ought to be considered ample, for only a small percentage of students would be able to afford six years in college. A mining engineer once told me that the schools which insisted on a course longer than the usual one of three or four years (I presume he had in mind one of the German centres of learning) frequently turned out men who, to borrow an expressive term, were "meticulously precise". It sometimes happens that certain data are required quickly and not altogether accurately. The man who has had a long scientific training has had inculcated in him a reverence for the greatest possible accuracy. For doing relatively precise work a highly trained man is liable to prove annoyingly slow. I give my friend's argument, for one must acknowledge that there is a little substance in it. Yet it is open to attack from so many points of view that I find myself unwilling to make the argument mine. An engineer who must have certain information right away has been asleep somwhere along the line. I believe a man would benefit far more from his attendance at college if he were to precede it with a year's practical experience. It is usual, of course, to spend a few weeks of each college year in a mine or mill. However, I do not think that these spasmodic efforts are of full value, because the average young man, and to meet the problem squarely we must bear in mind the average young man, looks on this period of work rather in the light of a pleasant change from the lecture-hall. As you point out, the medical student rightly serves a long apprenticeship. You perhaps remember the story of the *viva voce* examination at which the examining doctor after giving the details of a case asked, "How many grains of —— would you administer?" "Twenty", replied the student, and then on further reflection said, "No, sir, five grains". "Too late", was the rejoinder, "your patient is already dead". After I had left the university I realized how short a time was actually devoted to instruction. Three sessions annually, each one of 10 to 12 weeks. Subtract Sundays and half-holidays and there is not much left. While recognizing that the university is an institution where character ought to be molded and strengthened and where one should be taught how to think, I feel that more hours of each day should be spent in the lecture-room or the laboratory. Five or six hours daily are inadequate. I am therefore of the opinion that instead of lengthening the college period, from four years to six, the extra time necessary to embrace courses in economics, etc., could be made easily enough by calling for a seven-hour day. That would leave ample opportunity for social intercourse and evening study. I am glad you stand for an all-round rather than a specialized training. A mining engineer ought not to be dumb on every subject but mining. The university attempts to cover too much ground, so that the knowledge reposing in the brain of the graduate is a criss-cross of impressions rather superficially received and written in a species of short-hand which he himself cannot always decipher. I plead for the teaching of principles without an attendant mass of useless trimmings.

PAUL T. BRUHL.

San Juancito, Honduras, September 14.

Umpire Assays

The Editor:

Sir—A few days ago, during the course of conversation, an assayer of this city complained rather bitterly of the lack of a definite standard for umpire assays of gold and silver ores, and it seems to me that the time has arrived for making 'corrected assays' in determining the precious-metal content of these ores. By 'corrected' assay I mean adding to the ordinary fire-assay a correction, properly determined, for the loss in cupellation and when necessary for the loss in the assay slag. At present ore-contracts are made on the basis of payment for 95% (usually) of the silver content, which in turn is based on the theory that smelter losses average 5%. The fact of the matter is that while the apparent loss of silver may be 5%, the real loss varies with the ore treated and its true amount is obscured by the metallurgical gains made on the silver not paid for because of the cupellation and kindred losses.

The harm from this practice is due, not so much to the actual quantities involved, which are comparatively small, but to the lax work and uncertainties resulting, especially the uncertainties involving the umpire assayers.

W. J. Sharwood, at the conclusion of his experiments, says that the percentage of cupellation loss varies inversely with the cube root of the weight and is 1% for a 1000-mg. button of silver and 10% for a one-milligramme button. Contracts usually specify that silver is to be determined by the scorification assay and 0.2 A.T. is the amount usually taken for assay, so one milligramme

would represent 5 oz. per ton or $5 at the present price, and 10% would be 50c. per ton, a not insignificant item to large shippers. To this is to be added the uncertainty due to changes of heat and draft in the muffle, the presence of impurities, and the assay-slag loss. In the case of ores containing 100 oz. per ton the cupellation loss would be 3.7 oz. per ton, and if the ore contains zinc and tellurium in appreciable quantities it would be more. If the sample is referred to an umpire without statement as to the method of assay, he will have to decide whether to use crucible or scorifier and if the latter whether to use 0.1 or 0.25 A.T. for a charge, which of itself will cause a variation in the result obtained. Of course, he is supposed to act "in accordance with good practice", but does good practice demand that he should cupel three or four buttons together to reduce the loss, or does it not? It cannot be said that he should get the maximum amount possible because this might even be more than the silver in the ore. There is no definite answer to the question, but there should be, because this alone accounts for many discrepancies between shipper and buyer. Has the shipper the right to run three or four assays and scorify the buttons before cupelling so as to reduce the cupellation loss and if two why not eight? The practice seems to be that the shipper can run any number or combination, on which by umpiring he can win enough to pay for the assay bill. This is passing the buck to the umpire and is just the thing that was being complained about. Why let such a condition exist? Why not run proof-assays, as is done in bullion work, and if the amount be too small to pay for the work of a proof-assay then make a correction to bring the result to the 'proof' in accordance with the figure shown by practice to be necessary. The more accurate knowledge of the true precious-metal losses resulting from this practice would result in better recoveries in many cases. The only way to get the practice adopted is for the shippers to insist on its use, because naturally the buyer will not. In selling zinc-precipitate it is quite important.

C. A. Grabill.

San Francisco, October 16.

Oil-Shale and Shale-Oil

The Editor:

Sir—To answer your question off-hand, "What does it actually cost to mine a ton of shale?" is like answering similar conundrums, "How old is Ann?" How long is a piece of string? Where does Senator Harding stand on the League question?

Almost every group of shale-lands is a law unto itself. For instance, it is definitely known that at the Catlin property in Elko, Nevada, a 5-ft. vein of shale is now being mined at a cost of $1.25 per ton, and this figure is expected to be scaled down to $1 under steady operations, but this means nothing to operators in the adjoining States of Utah and Colorado, where conditions are quite different.

When I first became interested in the shale deposits of Utah, and after having sampled several of the beds that were practically free from overburden, it was evident that these deposits, ranging from 10 to 100 ft. in thickness, would have to be handled by up-to-date means and under the direction of an efficient mining engineer.

Fortified with photographic views of these workable deposits, I interviewed Daniel C. Jackling, of Salt Lake City, and laid the matter before him. Mr. Jackling advised the employment of the Stimpson Equipment Co., of Salt Lake City, and Mr. Paul T. Boise, of that firm, made an examination of the property and laid out plans for mining equipment, handling material to the crushing plant, and conveying same to the bins, estimating cost of same at less than 40c. per ton.

Last month I wrote to Mr. Jackling, asking for his estimate of mining cost on another group of shale-lands located in Rio Blanco county, Colorado, where there is a bluff of workable shale about 50 ft. thick, practically free from overburden, and at an elevation of 300 ft. above the proposed plant-site. In his reply, received a few days ago, Mr. Jackling estimates a figure of 50c. per ton as being safe for present calculations, comparing costs with those obtaining at the Chino and Nevada copper properties.

Underground mining of shale will present many difficulties, as shale is a stubborn product to deal with. I think, however, that James Doyle, of Denver, who has located and validated large tracts of land in both the States referred to, could throw light on this subject, as he is a practical mining man and the work done by him shows intelligent direction. I do not think, however, that much underground work, if any, will be undertaken so long as there are so many attractive quarrying prospects available.

The oil-content in the shale of the Uintah basin ranges from a trace to 60 gallons of oil per ton of shale with plenty of tonnage available that will average about one barrel of oil. These higher-grade shales will average in by-products about 27 lb. ammonium sulphate, 2% wax, and 5% asphalt Some thin strata ranging from two to four inches in thickness, show as high as 76 gallons of oil to the ton of shale, but no practical man would give serious attention to these small deposits.

The commercial success of the shale-oil industry will depend largely on the process adopted for destructive distillation, and we have now 57 varieties to choose from. One Denver 'scientist' claims to recover all the oil at a trifling cost, and then from the residue he extracts gold, silver, platinum, portland cement, fertilizers, and Liberty Bonds.

About three years ago, my attention was drawn to the Wallace process, at the St. Louis Gas Co.'s plant at East St. Louis, and after witnessing several tests, it not only appealed to me, but also to others. Acting on the advice of Dr. David T. Day, the Ute Oil Co. subsequently entered into a contract for the installation of a 250-ton plant, which is now nearing completion, and will be in operation the latter end of this year.

Through a friend of mine in New Brunswick, Mathew Lodge, who with his associate Sir William MacKenzie

owns the principal shale deposits of that Province, the Wallace process was recommended to the Anglo-Persian Oil Co. of London, as being worthy of investigation; and after a year's study their subsidiary company, the D'Arcy Exploration Co., decided to install an initial plant at Moncton, N. B., and their representative, John Henderson, is now on this side to close a contract with the Wallace company.

Taking a 5000-ton mining and retorting plant, and basing the cost of mining at 50c. per ton, crude oil should be produced at a cost not to exceed 80c. per barrel. A refining plant of like capacity would cost considerably more than the retorting-plant. Tests in refining have been made by the Wells Oil Refining Process Co., of Columbus, Ohio, and show a loss in refining of about 3%. The Standard Oil Co. at its research department, in New York, on recent tests shows a loss in refining of 2%. The loss in retorting will vary from 5 to 7%. The quality of the gasoline, lubricating oil, and wax is as good and possibly better than that refined from petroleum. The wax especially is far superior to any produced up to date and has been so admitted by the trade.

HECTOR MCRAE.

St. Louis, October 9.

The Price of Gold

The Editor:

Sir—Writing upon this subject in your issue of June 21, Mr. A. Moline stated, among other things, that no matter what the premium might be on gold as regards its value in paper money, its price in terms of itself, that is, in sovereigns, is still £4.25 per fine ounce (neglecting the fraction) and he showed by example how it could not be otherwise. This is tantamount to saying that one piece of gold can only be worth as much as another of the same weight and composition. Of course, if it were pure there could be no variation in its value.

One might think that such an obvious fact would be self-evident to everyone, but, on the contrary, it is one that is by no means universally recognized. The ignorance and misconception that exists regarding this once common medium of exchange is really quite extraordinary. This applies not only to its economic functions, but also to its physical qualities. The superstition and belief in its miraculous powers that so obsessed the minds of all throughout the Middle Ages is dying hard. Even many of those who are closely associated with its production have very vague ideas as to what is actually meant by the term 'fineness' of gold and the relation this bears to its value.

While engaged in running a custom mill I have often tried, with indifferent success, to explain to a prospector why his gold was worth, say, only £3 15s. per ounce when his ore had assayed so many pennyweights per ton, worth 4s. 3d. per dwt. And anyone who has had anything to do with a public treatment plant knows that these people are not wanting in acumen. A good many years ago I was in charge of a plant on a gold mine managed by one of the 'old school' mine captains. On one occasion it became necessary to re-smelt and refine a bar of cyanide gold that had previously been handed into the office. When the output was finally made up this individual was much perturbed to find that in spite of this particular bar being worth several shillings more per ounce, its total value was no more than before; it was slightly less, in fact. He remarked in an insinuating manner that he had observed a similar phenomenon on a certain occasion when my predecessor was in charge. I could only answer that although the coincidence was remarkable there was really no evidence of collusion. This does not profess to be a verbatim report of the conversation, which was chiefly a monologue consisting of "Where's it to, where's it to".

Even in better informed circles, and among those who, nominally at least, control the policy of some of our gold mines, one can see indications of the idea that the value of gold bullion depends upon some virtue, either peculiar to a certain mine, or that can be instilled into it by a metallurgical process, much in the way in which the quality of steel can be altered by tempering or annealing. It is probably this general failure to understand that the relative values of gold coin and bullion depend upon their respective contents in that element, and not upon some internal change, or even the impress of a ruler's head or other device, that enables quack political economists to foist upon the public those fantastic schemes for balancing the national ledger by diluting the gold contents, or reducing the size of coins.

W. B. CHOMLEY.

Broken Hill, Australia, September 13.

The Japanese in California

The Editor:

Your resumé of the Japanese question as it affects California is complete and you have called attention to its importance, but I do not think that you have adequately stated the problem or the conditions governing it.

The standard of living in the United States is the highest in the world today. This is not because of our natural pre-eminence in brain power and physical ability, much as we would like to believe it. We are the direct descendants of the people inhabiting European countries, and in many cases only one generation removed, so there can be little difference in natural mental and physical equipment. Our sandard of living is high because of natural resources, such as a favorable climate, and more acres of fertile land per capita than there are in any European or Asiatic country. This may hurt our pride, but it is true. We had the natural resources, ambition, and strength because of a suitable climate and proper food and so we devised the machinery to avail ourselves of the wealth at hand and thus became a nation of doers; but our standard of living has reached or nearly reached its maximum unless we take radical steps to preserve the conditions that permit its increase.

Before the War it was estimated that our standard of living required the produce of 15 acres of land per per-

son to maintain it. This does not mean that the produce of 15 acres of land had a value in dollars and cents that would pay for the material needed by one person under the present standard, but it means that, throughout the country, the corn, apples, cotton, barley, hay, and sugar-cane, used direct or as raw material, necessary for the average person, required 15 acres of land to produce them. Our standard of living has not been lowered since the beginning of the War, so the estimate of 15 acres per person made prior to that time is, to say the least, a moderate one. Now there are in the United States only a little over 18 acres per person and some of that is sterile. In other words, the country is at the present time approximately self-sustaining, but there is little or no margin. It is true, we are exporting raw materials such as meats and grains, but we are also importing an equivalent amount of coffee, sugar, rubber, tobacco, and wool. To obtain the raw materials cheaper than anyone else we must depend on South American and African products, and the amounts available are becoming insufficient for the whole world, consequently we must compete with European and Asiatic countries, which, because of their lower standard, are able to offer more labor in return than we can. In other words, there is no market large enough in which we can dispose of our manufactured products for raw products at a return that will enable us to maintain our standard. We can, of course, exchange manufactures with Europe and live, as the old phrase has it, by taking in each other's washing, but this is limited by the fact that in most cases Europeans or Asiatics can better afford to spend ten hours of lower-standard life than we can spend ten hours of higher-standard, so the market will be limited to a few things in which our conditions permit us to excel. The country with the lower standard can outbid the one with a higher as long as other conditions are equal, because in reality the bidding is in hours of labor, not in dollars.

The time has come therefore to restrict foreign immigration, Japanese or otherwise, if we are utilizing all our available land in producing raw material. We are not quite doing it yet, and California is one of the most favored States in the amount yet available, but we have already reached the point at which the law of diminishing returns applies, and the next decade will see the condition reached when it will be seriously felt.

We have the example before us, or at least those who live on the Pacific Coast have. The Chinese came here as a coolie class to work in the fields at a low wage. They came in direct competition with the white laborers in the early days and their further coming was stopped. The Japanese came in much the same guise, but only met a half-hearted opposition from the unions because it was said that they would not cut the ruling schedule of wages; besides, at that time there was a shortage of labor, or there were more opportunities than there were men, and the Japanese were content to take the places that the white man did not want. They are, however, not a servile race by nature and now they have come into direct competition, not only with day-laborer but also with the small storekeeper, the orchardist, and gardener, and even the large rancher and big merchant. By their willingness to cut prices and work longer hours they are forcing down the standard of living of the white race on the Coast; that is, they bid more hours of work for the best opportunities and there are not enough opportunities to go around. The Atlantic Coast has not felt this competition directly and hence regards their presence here with equanimity.

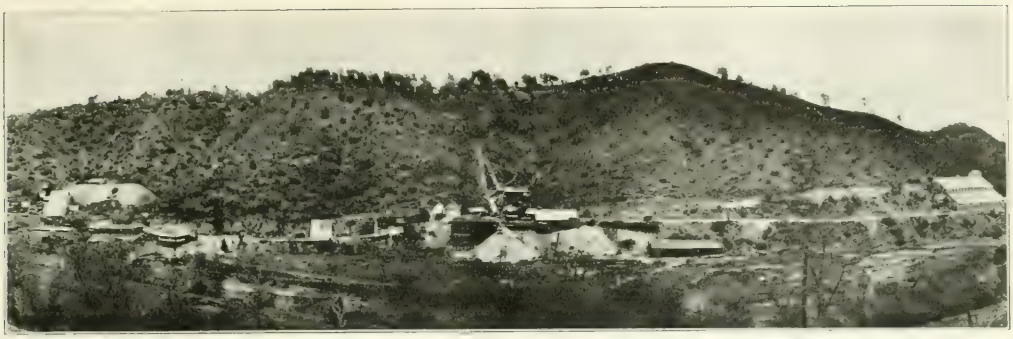
There are only two classes that desire the presence of the Japanese: The first is the employer of labor on a large scale. He needs more laborers than are available at the moment and besides he needs them to keep the misguided efforts and arbitrary actions (and sometimes not misguided ones only) of the labor-unions in check. Numerically this group is small but influential. The other class consists of those with a militant belief in the Universal Brotherhood of Man and therefore necessarily one great race of black and tans. Because the physical effect of Japanese immigration has been felt so far only on the West Coast this latter class is mainly in the East. When it comes down to bedrock facts very few people of any race, white, black, or brown, really believe in the one big race idea, but there is a large class of people who think they do, until brought face to face with the results.

I think the question is answered. I have seen it stated that California cannot prohibit the ownership of land by Japanese because the treaty between the United States and Japan permits such ownership, and the present law is therefore a violation of the treaty. The treaty provides that citizens of both countries may rent and own warehouses, buildings, etc., for residence and commerce and lease land for such purposes, but no provision is made for the purchase of land. Japan itself has a law prohibiting the ownership of land for foreigners, and this law applies to Americans. Furthermore, the treaty says "It is however understood that the stipulations in this and the preceding Article do not in any way affect the laws and ordinances with regard to trade, the immigration of laborers, . . . which are in force or may be hereafter enacted in either of the two countries". This is a provision that seems to cover amply any reasonable exclusion act that may be desired.

Then why all this outcry by Japan? Apparently it is a smoke-screen sent out to cover up their doings in the Orient, something to distract our attention while they repeat the Korean episode just as the cry for racial equality was raised at Versailles to furnish a *quid pro quo* for the Shantung (let us call it) appropriation. Japan's trade with the United States amounts to one-third of that country's foreign commerce. She cannot afford to have real trouble with us unless we have so far relaxed our vigilance that a victory in a clash of arms would be almost certain, but she is driven by the same force that will drive us in a few years if we do not put a stop to foreign immigration, and it is best to begin with the non-assimilable races.

C. A. Grabill.

San Francisco, October 20.



THE SHAWMUT MINE AND MILL

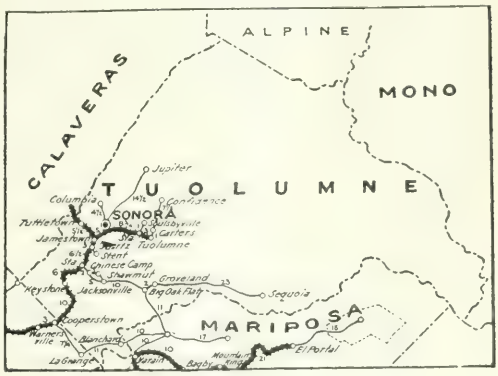
The Mine and Mill of the Belmont Shawmut Mining Company—I, The Mine

By ARTHUR B. PARSONS

Introduction. The operations of the Belmont Shawmut company are interesting for several reasons. The mine, formerly known as the Eagle Shawmut, is one of the oldest on California's Mother Lode; likewise, it is one of the most developed mines and it ranks among the first in the value of its past production. The Belmont Shawmut company is a subsidiary of the Tonopah Belmont Development Co., which owns virtually all of its capital stock, acquired at the time the Belmont Shawmut was organized in 1916. This is one of three promising properties that the Tonopah company purchased pursuant to its policy of utilizing its financial resources, as well as its excellent administrative and technical organizations, for the development of new mines, to supplement the profit derived from the remarkable bodies of gold-silver ore at Tonopah that first made the success of the parent enterprise. Although handicapped by the prevalent high prices for labor, material, and power, and by the additional burden that confronts any company whose output is gold alone, namely, the fixed price for its bullion, creditable results have been obtained. In order to minimize the cost of mining comparatively low-grade ore averaging less than $5 per ton, it was necessary to select the most economical methods of mining applicable to the orebodies, and to equip the mine mechanically for efficient operation. Of particular interest also is the development of a scheme for metallurgical treatment whereby bullion rather than concentrate is marketed. This treatment includes the cyaniding of raw flotation concentrate.

The mine lies somewhat south of the centre of the Mother Lode, about five miles east of Chinese station, in Tuolumne county (see map). It is near the site of the Hetch Hetchy reservoir, which is to supply water and power to San Francisco, and is on the main road to the Yosemite valley. The adjacent country is remarkable for its natural beauty, being rugged and not too thickly covered with timber.

Geology. The Shawmut vein is distinguished by the characteristic outcrop of massive quartz; it strikes N.



40° W. and the dip is approximately 70° in a northeasterly direction. The rock on the hanging wall is a schist, resulting from intense metamorphism of sedimentary rocks and is readily distinguished by its dark color from the lighter brown slate of the foot-wall. The width of the vein varies from 12 to 35 ft., the average being about 18 ft. Just beneath the vein proper is a layer of impure dolomite that varies considerably in thickness; this separates the vein from a band of gouge, which, because of its unusual character, has a peculiar bearing on the methods of mining. There are three fairly distinct

kinds of ore, although sundry intermediate types grade into them. The ore styled 'sulphide' contains little free gold, but about 9% of gold-bearing sulphides including pyrite, marcasite, and mispickel. In general, the sulphide orebodies are composed of a series of well-defined lenses, with their long axes horizontal; one shoot, south of the shaft, averages 25 ft. in width and is 500 ft. long. The north, or 'quartz', orebody contains a larger proportion of free gold and is more nearly a true-fissure deposit. A third kind of ore called 'schist' is found at different points throughout the mine; it contains a smaller proportion of sulphides.

THE MINE. At the present time the working entrance to the mine is a long cross-cut adit, untimbered for the most part and about 8 by 10 ft. in dimensions. At a point 1800 ft. from the portal the adit meets the old inclined shaft that formerly was used for hoisting ore to the surface 400 ft. above the adit-level. Some years ago the shaft-pillars above the adit were robbed to such an extent that the shaft was lost in spite of belated efforts to save it; a huge 'glory hole' on the surface, looking as though a good many thousand tons of ore had been taken from it, marks the site of the caved workings.

It was finally decided to utilize the adit for hauling the ore to the mill and to cut a large underground station in the hanging-wall side of the vein for the erection of the electric hoist and auxiliary equipment that had been at the collar of the shaft. Below the adit, the shaft was in fair condition, although in need of some repairs; there were two hoisting-compartments, 5 by 5 ft., and a manway, 5 ft. by 4 ft. 6 in.; and by swinging a short distance into the hanging wall, as further sinking was done, it has been possible to maintain the shaft at a reasonable cost. The hoist-room is 45 ft. long by 33 ft. wide and is timbered with five-member arches of 18 by 18-in. sawed timber spaced 6 ft. centre to centre. Smaller timbers would serve to hold the ground; the larger were used to ensure durability and avoid replacement. The important factor in first cost is not the expenditure for material, but for labor; and this is little more for 18-in. timbers than for the smaller ones.

The entire floor is concreted. A two-compartment raise was driven at an angle of 27° with the horizontal to accommodate the $1\frac{1}{8}$-in. round hoisting-cables running over 7-ft. sheaves, set on concrete pillars at a point 100 ft. above the level of the adit. This is shown in the accompanying sectional drawing of the underground crushing-plant. The hoist, set on substantial concrete foundations, was built by the Union Iron Works of San Francisco; it is actuated by a 400-hp. General Electric induction motor, which is connected through a flexible steel coupling and a large 16-in. herringbone gear to the hoist-shaft. The brakes and clutches are operated by compressed air and a set of C. R. Welch safety devices automatically applies the brakes in case of over-wind or excess speed. A small Giant duplex compressor independently supplies air for operating the hoist-brakes if the main compressor-plant at the portal is not running. Should the electric current fail at any time, the brakes on the hoist would operate automatically under the influence of heavy counter-weights. The centre of the 7-ft. drum of the hoist is 127 ft. from the sheave and 120 ft. behind the shaft-timbers. Power is brought to the vicinity of the hoist at 2200 volts and a bank of 125-kw. General Electric and another of three 75-kw. Wagner transformers step the current down to 440, all the underground motors, including those in the crushing-plant and in the various pumping-stations, requiring this voltage.

HAULAGE. In conjunction with the placing of the hoist underground, it was also determined to erect the coarse-crushing plant at the same point. Among the considerations that weighed, a few may be mentioned. The ore originally had been lowered from the hill above in a gravity tram. The portal of the adit, on the other

FIG. 3. SIDE-DUMP ORE-CAR

hand, was somewhat lower than the head of the mill, so that, if the coarse crushing were done outside the mine, elevating and conveying-machinery would be necessary. As it is, the mine-cars, by running on a slight up-grade after leaving the adit, can be dumped directly into the mill-bins. The hoist does the elevating and the amount of handling is reduced to the minimum. Another saving is the decreased time required to load crushed ore as compared with run-of-mine material; this has resulted in a considerable economy in equipment as well as labor. The capacity of the 450-ton storage-bins affords desirable elasticity in hoisting operations, with resultant saving. The design of the bins and the arrangement of the crushers is shown in the accompanying illustration, Fig. 1. The construction throughout is strong and substantial, and should require little expense for maintenance. Concrete is used generously, with reinforcement where needed, for example under the crushers and the floor of the coarse-ore bin. Above the bins are 33-ft. arches similar to those that support the roof of the hoist-station.

Three-ton steel skips made by the Angels Iron Works dump directly into the bin, which holds 300 tons. The gates of this bin are of the finger type, seven individually counter-weighted fingers constituting each gate. One

man operates the two No. 5-D Gates gyratory crushers set to crush through a two-inch ring; they are driven by a 75-hp. General Electric induction motor connected to the line-shafting through a flexible leather coupling. A 10-in. double leather belt with short-centre drive runs one crusher, while for the other a 12-in. six-ply Good-

was discarded as being troublesome and unnecessary.

Loading from the crushed-ore bin is done through four arc-type gates, the details of which are shown in the sketch, Fig. 2. A novel feature is the operation of these gates by compressed air in a pivoted cylinder to which the air is brought through short flexible hose connections.

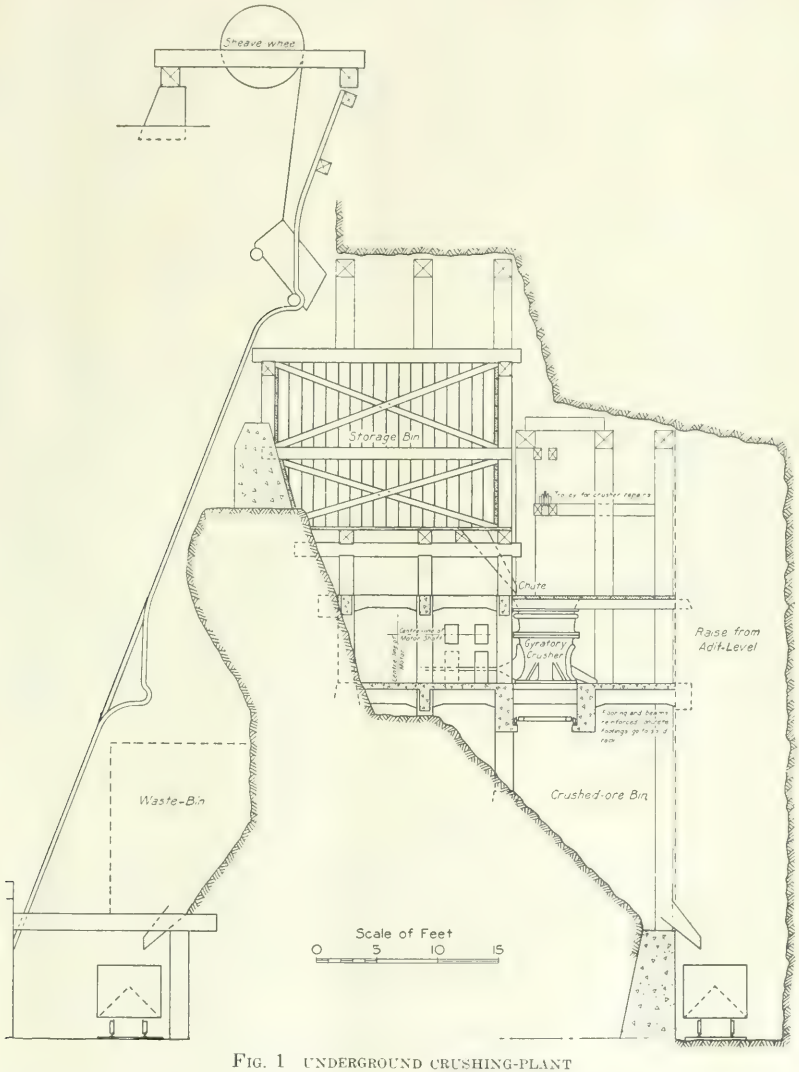


FIG. 1 UNDERGROUND CRUSHING-PLANT

rich Blue-streak is used. One crusher is equipped with a manganese-steel mantle, which has crushed 75,000 tons and is expected to crush 250,000 more, while a solid head of chilled steel on the second was discarded after crushing 75,000 tons. The concaves are made in two sections, the upper, 13 in. long, being made of chilled iron, and the lower six-inch section being of manganese-steel. A traveling grizzley was planned to precede the crusher, but this

The loader operates the gates while standing on a platform on the side of the car opposite the chute. A hinged lip balanced by a counter-weight is available in an emergency to catch possible runs.

The pumps underground are operated by electricity, although several air-pumps are placed at critical points to serve in the event of the failure of electric power. It may be mentioned that the company has some water-

power available as an alternative, so that compressed air may be supplied independently of electric current. On the sixth level, 450 ft. below the adit, a Deming horizontal 6 by 8-in. triplex pump run by a 25-hp. General Electric induction motor raises 150 gal. per minute through a 4-in. column. The mine does not make a great quantity of water and an old drift in which has been built a concrete bulkhead has a capacity sufficient to store the accumulation of 48 hours. A Snow steam-pump, connected with the air-line, can be used if required. From the 16th level, 1834 ft. below the adit, an Aldrich 4 by 10-in. vertical triplex pump relays 100 gal. per minute to the reservoirs on the sixth level, while a smaller pump, of similar manufacture and type, provides for the water made between the 16th and 18th levels.

On the 18th level at the shaft-station there is installed a Sirocco fan, or blower, with a capacity of 30,000 cu. ft. per minute, run by a 50-hp. Westinghouse induction motor. The mine had always been warm, and when the lower levels were opened this condition became more marked. The blower was placed at the back of the station and a light wall was built to separate the station from the hanging-wall drifts, north and south. The intake of the fan is on the station side of the wall, where fresh air from the down-cast shaft prevails; the outlet enters the drifts on the opposite side of the wall. The machine therefore acts both as a suction-fan and as a blower, the result being a decided improvement in the atmosphere of all the workings. A raise at the north end of the mine, now partly completed, is to be equipped, when finished, with another fan, to further stimulate circulation and improve ventilation. The company's policy is to make conditions comfortable for its men, but at the same time it appreciates thoroughly the good influence of desirable conditions on operating account as a result of increased efficiency of its employees.

Mining Methods. The stations on the lower levels are 10 ft. high, 20 ft. wide, and run back 45 ft. Except for a brow-set there is no timbering; this speaks well for the character of the rock of the hanging wall. The ore-chutes, or skip-pockets, with a capacity of 225 tons, are made by raising in solid rock from a point 50 ft. below the floor of the station. The front of the pocket is 28 in. behind the shaft-timbers at the bottom, and is vertical.

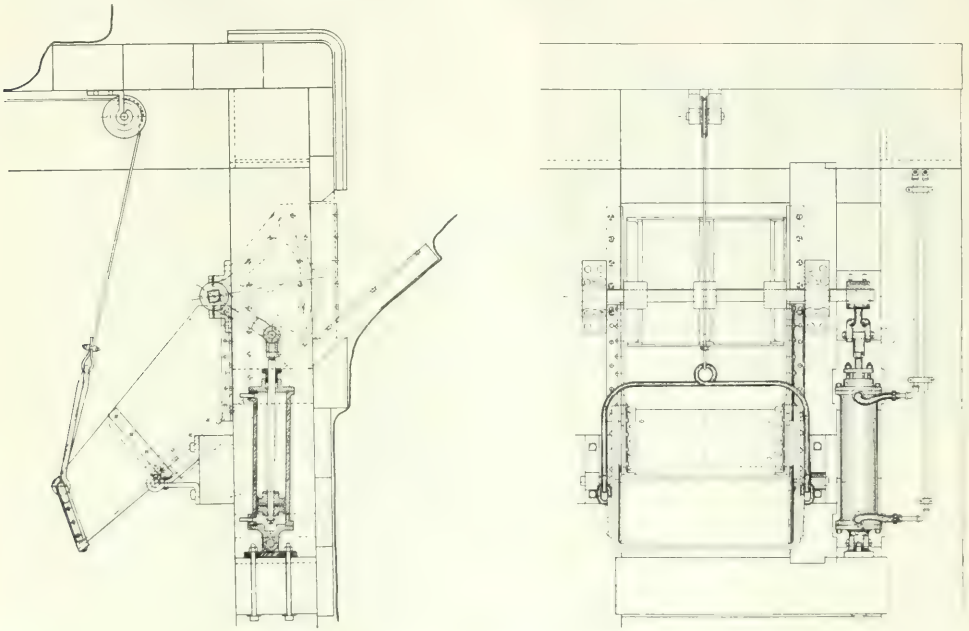


Fig. 2. ARC-GATE OPERATED BY COMPRESSED AIR

The steel gates are operated by compressed air and the chute-lips are folded up each time a skip is loaded. Just above the pocket for ore, and separated from it by a pillar of solid rock, is a smaller one for waste. The grizzley over the ore-chute is novel. It is 12 by 10 ft. in area and is composed of old stamp-stems, spaced 8 in. apart and laid 3 ft. below the level of the track. The large size permits as many as eight or ten cars to be dumped at once, so that tramming need not be obstructed, while the car-men are breaking the large pieces. One-ton side-dump cars of the cradle-type, manufactured by the Angels Iron Works, run on tracks on either side of the grizzley. This car, shown in Fig. 3, is highly esteemed at the Shawmut. It is simple in construction and easily and safely operated. Large rocks cannot jam in it and there are no gates, hooks, or levers to get out of order. It is substantially built, has roller-bearings, and seems to be an ideal car for the requirements at this mine.

For drilling in development work and in shrinkage stopes the Ingersoll 148 and 248 machines and a few Waugh 'Dreadnaughts' are used. Ingersoll stopers, type CC-11, are preferred for raising and for stoping in the schist ore, while Ingersoll 'Jackhamers' are used for plugging and similar work. A central shop near the station on the 16th level has been established, where crippled drills are brought for repair and adjustment. Judging from several thousand holes that have been punched in solid rock, a drill does not leave this shop until its efficiency has been demonstrated by actual test. Saws, axes, and hammers also come here for repair.

During the latter part of 1919 a number of changes were made in the methods of mining. Formerly, when the heavy sulphide orebodies were worked by the ordinary square-set and fill methods, huge blocks of ore, often including lenticular masses, broke away and crushed the timbers beneath them. Bulk-heading of every alternate set was tried, but even then the pressure was so great as to completely close the working-floor, breaking or driving the timber down into the filling, so that if recovered at all the ore was obtained slowly and at great expense. Accordingly a system of top-slicing first was tried experimentally and then applied successfully in places where the level above had been mined and the old fill lay above the block to be stoped. Untimbered chute-raises, 4 by 7 ft., at 50-ft. intervals, in the hanging-wall side of the vein, were run through the ore to be removed. Mining was commenced at the point nearest the shaft just beneath the old fill on the upper level. A cut was taken immediately on the hanging wall and run to the opposite end of the shoot, being timbered with light sets sufficiently strong to hold for a short time. The next step was to retreat from the extreme end, taking the remainder of the vein as far as the foot-wall, the only support being occasional stulls with a large head-board to protect the miners. As soon as the timbers in the completed slice begin to take weight they are blasted, thus allowing the mat of old timber and overlying 'gob' to come down to the floor-level. Having reached the starting point, the next slice below is taken in exactly the same way. As the stope is carried down, a manway, above the chute-raise, is lagged and kept open to afford communication with the upper level. This system proved to be much less expensive, less dangerous, and more rapid than the old square-set procedure.

For work in the lower levels also a method of shrinkage stoping has been adopted, some features of which are of interest. Chute-mouths are inserted at intervals of 10 ft., centre to centre; they are 3 by 4 ft. in the clear, constructed of 3 by 12-in. plank. The purpose of this close spacing of the chutes is to maintain an approximately level, rather than a wave-like, top when drawing the stope, so that wall-rock and waste will follow uniformly with the minimum amount of mixing with the ore. Cribbed manways, at intervals, are advanced with the stope, which when once started must be pushed rapidly to prevent loosening of the ore overhead. This is one of the essential points on which the success of the scheme depends. When the stope has advanced to within 30 ft. of the upper levels, raises are driven through at intervals of 40 ft. and the pillars are blasted in succession, beginning at the end of the stope farthest removed from the shaft, thus allowing the old filling from above to run down and follow the ore as drawing proceeds.

Stopes are worked so that the unmined portion of the vein forms an arch, which lessens the possibility of falling ground; where the stope is more than 100 ft. long a double arch may be established. The middle pillar rests upon broken ore until the crown on each side is advanced 20 ft., after which the pillar is blasted and new arches are started. The distance between levels is 200 ft., but below the 19th this interval is to be increased to 300 feet.

In the quartz orebodies, on the north side of the shaft, a shrinkage method with some modification has been introduced. A series of grizzley chambers 25 ft. above the sill, lagged on the hanging-wall side of the vein for the protection of the workmen, enables the breaking of the ore to shoveling size before it enters the adjacent chute. Above the chambers the work is done as in the stopes just described.

In the most recent development work, on the lower levels, laterals or hanging-wall drifts are driven 15 ft. from, and parallel to, the vein instead of following the ore. Cross-cuts at irregular intervals are then driven to the lode itself. Experience has shown that timbering in a drift on the vein will be replaced at least twice and frequently three times before the ore is mined; and since this kind of work is particularly slow and expensive there is obvious economy in placing the laterals at a reasonable distance in the wall, where any timbers that may be required will last as long as the ground must be kept open.

The hanging wall is invariably good, but the foot-wall generally gives trouble on account of a layer of gouge material, underlying the talc and dolomite that forms the immediate foot-wall. As soon as the wall is exposed, the gouge swells, cracks the dolomite where it is less than 15 or 20 ft. thick, and exerts such a pressure within a short time that no timber, apparently, is able to withstand it, although it seems that after proceeding to a certain point this swelling ceases and the excessive pressure is abated. Fortunately the swelling is not sufficient to close up a stope, so that there is always a passage for the ore in shrinkage operations, even after a considerable period has elapsed. The appreciation of this fact obviously was fundamental in the development of the mining practice.

The ore from the underground crushing-plant is hauled through the adit in trains of two 6½-ton side-dump cars with 30-in. gauge, 300 tons being delivered in an eight-hour shift. The locomotive was built by the Moore & Scott Iron Works of San Francisco and is propelled by two 30-hp. General Electric direct-current motors, one of which is geared to each axle. Current, supplied from an overhead trolley-wire, is converted from alternating to direct by a General Electric motor-generator set at the portal of the adit. The motor is 60 hp., induction type, and the generator operates at 1200 r.p.m., producing 145 amperes at 250 volts.

COSTS. The following figures include the operations during 1919 and indicate the results obtained. It should be remembered that at that time the efficiency of mine labor everywhere, as indicated by the output per man, was low; the miner was not producing at the rate of a few years before.

	Tons of ore
Per man in stopes	4.60
Per man on development	3.19
Per man underground	3.84
Per mine employee (including surface-men)	3.25
Per drill-shift in stopes	28.09
Per drill-shift on development	5.49
Per drill-shift (total)	21.18
	Tons ore and waste
Per mine employee (including surface-men)	3.30

An analysis of the mining cost for the operating period of 1919, during which time the average monthly tonnage was 12,759, is shown below, the details being given for the purpose of interesting comparison.

Tabulated Costs

Development, direct	Labor	Supplies	Power	Total
Miners	$0.094	$0.005	$0.014	$0.113
Muckers and trammers	0.033	0.001	....	0.034
Timbermen and helpers	0.012	0.007	....	0.019
Stoping, direct				
Miners	0.164	0.011	0.031	0.206
Shovelers	0.316	0.007	....	0.323
Trammers	0.275	0.006	....	0.281
Filling	0.004	....	....	0.004
Timbermen and helpers	0.092	0.067	0.003	0.162
Piston drills, repairs, and maintenance	0.002	0.019	....	0.021
Stoping drills, repairs, and maintenance	0.004	0.014	....	0.018
Steel and sharpening	0.018	0.013	....	0.031
Explosives	0.007	0.193	....	0.200
Hoisting underground	0.075	0.016	0.020	0.111
Auxiliary hoisting	0.010	....	0.008	0.018
Pumping and ventilating	0.019	0.006	0.032	0.057
Sampling and assaying	0.007	0.006	0.001	0.014
Surveying	0.016	....	....	0.016
Superintendent and shift-bosses	0.072	....	....	0.072
Surface and plant	0.015	0.016	0.003	0.031
Lighting	0.003	0.010	0.002	0.016
Tram to mill	0.012	0.004	....	0.018
Drayage	0.001	0.003	....	0.004
Maintenance and repairs of buildings	0.001	0.001	....	0.002
M & R. tools	0.003	0.002	....	0.005
M & R. pipelines	0.003	0.008	....	0.011
Total cost direct mining	$1.258	$0.415	$0.114	$1.787
Administration	....	0.035	....	0.035
Mine office	0.027	0.010	....	0.037
Taxes and insurance	....	0.086	....	0.086
Legal and traveling expenses	....	0.001	....	0.001
General expense	0.001	0.019	....	0.020
Total cost indirect mining	$0.028	$0.151	....	$0.179
Cost per ton	1.286	$0.586	$0.114	$1.966

Sodium Sulphate

There is a demand in Sweden for sodium sulphate, the paper manufacturers generally being in need of supplies. If American manufacturers of chemicals can promptly satisfy the present demand at reasonable prices a steady market will be assured, according to the U. S. Department of Commerce. The Swedish Paper Mills Association of Stockholm uses on an average 40,000 tons of sodium sulphate per year, and the manufacturing director states that orders will undoubtedly be forthcoming as soon as sure sources of supplies are found.

Wood-pulp for paper manufacture is likewise an important and flourishing Swedish industry, its future being assured by the vast timber supply of the country. In 1919 there were 807,761 tons of wood-pulp exported from Sweden, the value of which was $13,649,000. The wood-pulp industry is likewise in need of a steady supply of sodium sulphate, the home manufacture being by no means sufficient to meet the demand.

The Flotation of Graphite

Much interest has been shown in the last year or two in the possibilities of oil-flotation for the concentration of graphite ores, and it has been demonstrated that by this system flake graphite can be treated both cheaply and efficiently, says the 'Canadian Mining Journal'. The avoidance of the preliminary drying of the ore, necessary in all methods of dry concentration and in surface-tension or film flotation, is an important consideration from the standpoints of expense and mill-capacity. Additional features are, that a much smaller mill building, involving less initial expenditure, is required to treat an equal tonnage of ore as compared with dry concentration; that there are fewer machines and appliances requiring constant attention and repairs, and that a smaller force of men is required for operation of the plant. A number of graphite mills in Alabama are employing oil-flotation machines of one type or another at the present time, and the system has also been applied successfully to Pennsylvanian ore. In both cases, the ore treated is of relatively low grade, carrying only 3 to 5% of graphite. Oil-flotation has also been adopted by the American Graphite Co., in New York, and is reported to be giving satisfaction. The New York ore is similar in its general characteristics —hardness, texture, and associated minerals—to the Canadian graphitic-gneiss ore. A number of tests with oil-flotation have lately been made on Canadian ores, and a Callow plant was installed in August 1914 at one of the mines in the Buckingham district. Unfortunately, however, the mill was destroyed by fire before the system had had an opportunity of being properly tried out. Three Canadian mills have since been equipped with this system of oil-flotation.

THE engineer of today who wants the latest thing in surveying instruments at a thousand of the company's dollars per transit often fails to realize what really good work can often be done with inferior instruments, or even with no instruments at all of modern design. The ancient Egyptians certainly did not have the modern transit and spirit-level, nor even the science of trigonometry, yet as a record of their achievement it is stated "the highest pitch of accuracy on the large scale was reached under Khufu in the IVth dynasty; his pyramid had an error of less than 0.6 of an inch on its side of 9069 inches, or 1 in 15,000, and its corners were square to 12 seconds. A change of temperature during a day would make larger errors than this in a measuring-rod. The accuracy of levelling and of finish of the stone is on a par with this; joints over six feet long are straight to a hundredth of an inch. . . . In smaller work, a beautiful sarcophagus of Senuser II, which is ground flat on the sides with a mat finish like ground glass, has only about a two-hundredth of an inch error of flatness and parallelism of the sides." This degree of accuracy would not be expected today in works of the same type and we can only speculate as to how it was accomplished with the inferior tools of that time.

Fighting Mine-Fires

By H. J. RAHILLY

*The mining industry, like all other industries, has to guard against the possibility of fire, which, in the case of a fire underground, is apt to be more serious than a surface fire, both as to personal injury and financial loss. In combating a mine-fire the handling of the gas is generally a much bigger problem than the actual putting out of the fire.

Butte, like most mining districts, has had several mine-fires in the past, and today there are several mines fighting fire in districts that are walled off by concrete stoppings (bulkheads).

The chief causes of such fires are:

1. Defective electrical equipment.
2. Incendiarism or carelessness.
3. Spontaneous combustion.

The use of electricity in the mines for running pumps, fans, motors, electric lights, shaft and signal bells has made it necessary to use wire covered with a good grade of insulation and cables insulated with a lead or asbestos covering. Care must be taken to see that these wires are placed where they will not be hit or injured, and in the case of trolley-wires, to see that the hangers are well insulated. On account of the acid water in most of our Butte mines, ordinary insulation is soon eaten away if the wires are in a wet place and frequent inspection is necessary, so that a bare wire will not come in contact with some inflammable material.

Incendiarism or carelessness has been the cause of numerous small fires, but these have been discovered before they became serious and were extinguished.

The other cause of mine-fires, spontaneous combustion, has been the origin of most of our large fires. Inflammable materials, such as tarry ropes, canvas, dry timber, manure, and hay have been left in the gob some years ago, and, owing to ground movement and decomposition, heat has been generated sufficient to start a fire, also the heat resulting from the oxidation of the fine sulphide ore is sometimes sufficient to set fire to the timber. These fires are serious because they generally occur in parts of the mine that have been mined out, caved, and are inaccessible.

At the present time, the places that are most susceptible to fire, such as working shafts, stations, cross-cuts and drifts having high-tension wires in them, motor, fan, and transformer stations, oil-houses, and powder-magazines are covered with 'gunite', or cement mortar, so as to make it difficult for a fire to start.

Concrete stoppings (bulkheads) with iron doors are placed near the shafts on each level throughout the different mines so that should a fire start it can be isolated to some extent.

*From 'The Anode', the monthly publication of the Anaconda Copper Mining Co.

When a fire is discovered, inspection trips are made with oxygen apparatus, if necessary, to locate, if possible, the extent and exact location of the fire. This is not always possible because sometimes the fire is in old worked-out stopes that are inaccessible. At the same time that inspection trips are being made to locate the fire, the directions of the air-currents are noted and steps are taken to control the air, so as to keep the gas from traveling to other parts of the mine. All operating shafts are down-cast, and the ventilation underground is so controlled that the gas from the known fire areas is disposed of, through up-cast shafts without passing through the active working-places.

If the territory affected is small and easily accessible, hose-lines are played upon the fire until it is put out; if, on the other hand, it is impossible to get to the active fire, concrete stoppings are started so as to completely isolate the territory affected, and to keep as much air from the burning country as possible. After this has been done cross-cuts or diamond-drill holes are put in from different places, on levels above where the fire exists, and water is then turned into the burning country through these cross-cuts or drill-holes.

In handling a fire in a Butte mine, three principal gases are encountered.

1. Carbon Monoxide. This gas is produced by the fire burning in an atmosphere where there is insufficient oxygen for complete combustion. This gas is lighter than air, is colorless and odorless, and has no effect on a lighted candle or carbide lamp. Carbon monoxide is the gas that forms a blue flame above a coal-fire, and in the impure state, as found in the mines, it has a characteristic odor and is known locally as 'sweet gas'. Carbon monoxide, even in small quantities, is very poisonous to the human system. Its presence underground can easily be detected by the use of small birds or mice, these animals being more susceptible to the gas than is a person.

In Technical Paper No. 11, George A. Burrell, of the U. S. Bureau of Mines, gives the following table showing the relative susceptibilities of mice and canaries to carbon monoxide poisoning:

Effect of CO on Mice and Canaries

Mice		Canaries	
CO. %	Effect	CO. %	Effect
0.16	Very slight distress at end of hour.	0.09	Very slight distress at end of hour.
0.2	Distress in 8 minutes; partial collapse in 15 minutes.	0.12	Weaker at end of hour than after exposure to 0.09%.
0.31	Distress in 4 minutes; collapse in 7½ minutes; lost muscular power in 35 minutes.	0.15	Distress in 3 minutes; fell from perch in 18 minutes.
0.46	Distress in 2 minutes; collapse in 4 minutes.	0.20	Distress in 1½ minutes; fell from perch in 5 minutes.
0.57	Distress in 1 minute; collapse in 2 minutes; muscular power lost in 7 minutes; death in 16 minutes.	0.29	Fell from perch in 2½ minutes.
0.77	Distress in 1 minute; muscular power lost in 6½ minutes; death in 12½ minutes.		

Also the following giving the 'Relative Susceptibilities of Men and Birds'.

"In order to determine for himself the relative susceptibility of men and birds to the action of carbon monoxide, the author performed the following experiment:

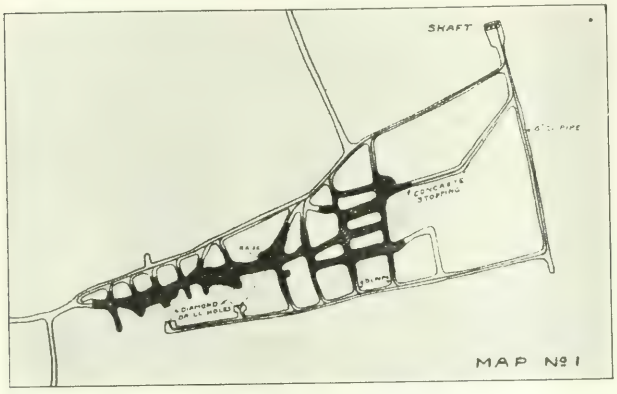
"A gas-tight chamber, having a capacity of 80 cubic feet, was constructed. Into this chamber sufficient carbon monoxide was introduced to produce an atmosphere containing 0.25% of the latter. The author entered this atmosphere, taking with him canary birds and pigeons. The canary birds evinced distress in one minute and fell from their perches in three minutes. The pigeons only showed slight signs of distress in 11 minutes. The author remained in the atmosphere for 20 minutes, and at the end of that time only suffered a slight headache, although later he became ill. The illness lasted several hours and was accompanied by nausea and headache.

"The experiment shows that small birds are much more susceptible to the action of carbon monoxide than are men, and demonstrates the desirability of using small birds, such as canaries, rather than larger ones, such as pigeons."

2. Carbon Di-oxide. This gas is colorless and odorless and will extinguish a lighted candle or carbide lamp. It is formed by the burning of the timber and is dangerous in that it replaces the oxygen in the air, but it has no poisonous effect on the human system.

3. Sulphur Di-oxide. This gas has a very characteristic odor, like that of smelter smoke and when breathed causes a very disagreeable and irritating feeling in the throat. This gas is formed from the burning sulphur in the broken ore.

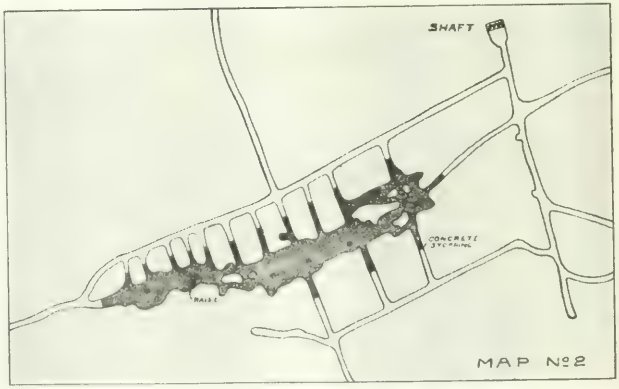
For the past two years mill-tailing has been used to reclaim one of the fire-zones, which had been sealed with concrete stoppings at the time of the fire. Map No. 1 shows a level, the shaded portion representing the country that was sealed off and which subsequently has been filled.



These drifts and cross-cuts were opened up sufficiently to allow pipe-lines to be put to the tops of the different raises or, if this necessitated considerable labor, diamond-drill holes were run to the raises that were inaccessible. Six-inch extra-heavy cast-iron pipe conveys the tailing down the shafts to the various levels where 4-in. lateral pipes run off to the stopes. Where diamond-drilling has been resorted to, the holes are 'fanned out' to cover the entire stope. These drill-holes are 2½ inches in diameter and are cased with 2-in. extra-heavy pipe, these casing-pipes being connected by means of short pieces of fire hose on the 4-in. lateral lines.

On the level below, as shown on Map No. 2, the concrete stoppings have been reinforced so that they are about five feet thick, and are provided with two 2-in. copper drain-pipes in each stopping. Valves are put on these 2-in. pipes and the water from the tailing that is put in on the level above is drained off. This water carries copper in the form of copper sulphate and is pumped to the surface, where the copper is recovered at the precipitating plant.

The tailing, which is the finely-ground waste material from the flotation process, averages about 600 gal. of water per ton of solid. Before entering the mine it passes over a weir that is equipped with a hydro-chronograph, which mechanically records the volume of water and solid passing; samples are taken every half-hour and from these, calculations are made as to the amount of solid and water entering the mine. Several stopes are kept available for filling at all times and an account is kept of the amount of tailing going to each. All water pumped from the mine passes over a weir also equipped with a hydro-chronograph and, by means of this, account is kept of the water that is drained from the stoppings. In this way no large reservoirs of water are allowed to accumulate in the stopes.



In opening up a level so as to introduce the tailing, either new cross-cuts are driven around the old workings

from which drill-holes or short cross-cuts are run to the fire-stopes, or the old workings are repaired. In case the latter method is pursued, air-locks are built in front of the concrete stoppings, consisting of two brattices built about 15 to 20 ft. apart and provided with tight doors.

These brattices are made of inch boards covered with metal lath and coated with gunite or they are made of burlap over which chicken-wire, with inch openings, has been stretched, and then gunited. A small Sirocco fan, either No. 2½, No. 3½, or No. 4 is placed outside these two brattices in a place that has free access to fresh air. The fan-pipe, which is 12 or 16 inches in diameter, is a canvas pipe and is carried through the two brattices above the doors. The concrete stopping inside is then blasted open and the work of repairing or putting pipe through the drift or cross-cut to the stopes is started.

The fan is thus used to hold back the gases that are in the fire-area and make it possible for the men to work in fresh air. Much of the preliminary work of repairing drifts, guniting stoppings, and opening up new places is performed with oxygen apparatus. In some places, where the ground is badly fractured and broken, considerable difficulty is experienced in keeping the tailing from leaking through the rock. In these places the loose ground is removed and several coats of gunite applied.

The tailing was first put into the lowest levels of the fire-zone and built up from this foundation. From 2500 to 3000 tons is introduced each week, the process being a continuous one. Up to the present time nearly 300,000 tons of tailing has been used.

Ore-Reserves of the Rand

"With the publication of the last of the annual balance-sheets and reports it becomes possible to give a complete table of the ore-reserves of the whole Witwatersrand—the stock-in-trade of the industry upon which productive operations are dependent," says 'The South African Mining and Engineering Journal'. "The features of the year's activities on the Rand in regard to productive operations—that is to say, the incidence of the gold premium and of rising costs—are reflected in the development figures. It is to be noted that some companies show the additional tonnage which is represented in the ore-reserves with gold at a definite premium (in the attached schedule the General Mining & Finance Corporation shows additional reserves in respect of a premium of 30%), whilst other companies take no cognizance of the extra price.

"At the end of 1918 the payable ore-reserves of Witwatersrand mines were estimated at ninety million tons, which was approximately a decline of six million tons compared with the estimates of a year previously. The outstanding feature of the year's work on the Witwatersrand in regard to ore-reserves during 1918 was that, although development was 'speeded up' on the Far East Rand, the increase in working expenditure compelled the elimination of millions of tons of low-grade ore from the estimates of payable reserves. Since the outbreak of hostilities in Europe and up to the end of 1918, the costs of operation on the Rand increased by the equivalent of 1½ dwt. per ton, and in consequence large areas formerly reckoned profitable were ruled below the pay-limit, whilst at the same time there was a general increase in the value of 'pay' ore on account of the rise in costs. In December 1918, working costs were 21s. 7d. per ton, and by December 1919 they had risen to 25s. 6d. This is a very substantial advance in the costs of operation, and under normal circumstances there would have had to be a further large shrinkage in the payable reserves of the mines as at the end of last year due to the raising of the pay-limit. The gold premium, however, luckily came to the rescue. But for this fortunate circumstance the payable ore-reserves of the Main Reef series would have contracted to a figure which would have greatly impaired the credit and stability of the industry. For ore-reserves are the stock-in-trade of the Rand, and a marked diminution would have been highly detrimental to the prosperity of the whole Union. On the old basis of gold-values an average working cost of 25s. 6d. per ton meant that the mines had to recover not less than 6 dwt. per ton milled in order to pay expenses. Leaving aside any question of profit or dividend to shareholders, 6 dwt. per ton had to be yielded in order to meet the routine of normal expenditure. At the end of 1918 there were 13 companies with 'payable' ore-reserves of a lesser value than 6 dwt. per ton.

"With costs at their present level an average value of 6½ dwt. in the blocks is required to yield profits. It is to be observed that 25 companies with ore-reserves amounting in the aggregate to 38⅓ million tons, give values of 6½ dwt. or less per ton.

"The total payable tonnage in the mines of the Rand at the end of last year was approximately 91,500,000 tons, or an increase of about 2½ million tons on the figures for a year ago."

A RECENT visitor to Colombia says: "The extremely liberal mining-laws render it possible to select and hold enormous concessions at a nominal cost, but at the same time this facility has the effect of enabling the owners to hold on to their mines until they believe that they are fair if not generous terms. Many large concessions have been held for years, and, in some cases, for generations. A thorough knowledge of dealing with the natives is as important as technical judgment in acquiring Colombian mines; above all, any expedition sent out to investigate Colombian properties, whether mines or otherwise, must show no signs of haste; neither must any anxiety be exhibited to close a deal. These are the two principal points that have often been neglected and their neglect has held back the development of Colombian mines."

WHEN A HOLE has misfired an effort should be made as soon as possible to have it fired. Holes loaded with explosives are dangerous. If it is not practical to fire the hole at once, it is better to place a plug in the hole or mark it in some way so that the miners will be notified of the danger.

Labor the Holder of the Nation's Wealth and Income—III

By W. R. INGALLS

*I have not in this or previous essays on the same subject propounded any new theory, but rather have I merely illustrated the practical working of things according to the theories of such economists as Jevons and General Walker. Even my statistical reasoning simply follows what has previously been done by Mallock, although, with the benefit of recent and more detailed statistics for the United States, I have been able to make a more minute analysis of the division of income.

One of the outstanding features in all of these studies is the tremendous part that mind has played in the increment of national income, with the constant reversion of the major part of that increment to the multitude of wage-earners. I may usefully cite some homely illustrations of this from the metal-mining industry, one of the great basic industries, with which I am especially familiar and in which I have played some part.

One of the greatest and most profitable branches of metal-mining is copper mining. The gross income of the profitable mines (nearly all were profitable) in 1916 was about $555,000,000 and their net income (but not their dividends or their earnings really applicable to dividends) was about $271,000,000. It was a year of phenomenally high prices and extraordinary earnings. However, the bulk of this great production was derived from mines that would not have existed in 1916 as mines at all had it not been for improvements in the arts of mining and metallurgy effected within the previous ten years. As recently as 1906 so astute and distinguished an authority as J. R. Finlay viewed the Anaconda mines as decadent owing to the impoverishment of their ores, yet since then we have seen them ascend to greater production and profit than ever before. This was due distinctly and entirely to the most brilliant exhibition of mind that has ever been witnessed in any industry in modern times.

In 1906 the vast deposits of copper ore that are now the source of a major part of the American production, classed generically as the 'porphyry' mines, were useless to anybody. They had been known for decades, they were practically free to acquisition by anybody, but their copper contents were too small to be extractable. Some engineers who were then poor men conceived their exploitation by new methods. In order to carry them out they had to tempt investors to supply fabulous sums of money, as much as $10,000,000, for the equipment of a single mine. These investors had to wait years for any return, during which it was uncertain whether they might not lose all the money they had risked, for they were adventuring in an untried field.

These great increases in the national income were made by mind, with the aid of capital, without which the mines of Butte would today have been nearly dead and the 'porphyries' would not have been born. They were in no wise at the expense of wage-earners, nor have the latter any claim upon them beyond that which economic law gives them, and what it does give they have received. Their ability to work has been greatly increased and they have got higher wages for their work. Thirty years ago the common rate of wages for miners in the Rocky Mountains was 30c. an hour. During the '90s it rose to 37c. in Butte. During the next decade it rose to 47c. In 1916 it was 60 and 65c. During the last ten years wages have been paid largely on a sliding scale, according to the price of copper, whereby the wage-earner has participated in the increased profits of the employing companies. The Butte scale governs, to a more or less extent, the wages in other districts, with modifications according to living conditions, character of work, etc. Labor's great gain in mining has been due to mind, aided by capital, enabling it to produce more. Without mind and capital it would not have had any gain. With mind and capital both of them profited greatly, but labor profited most.

Probably the full working power of the nation is never employed at any one time. According to the U. S. Census of Manufacturers the average number of wage-earners in the factories in 1914 was 7,036,337, and the general computations are made upon that basis. The maximum number in any one month was 7,242,752 and the minimum 6,640,284. The minimum was 91.7% of the maximum. The average was about 97%. The figures for 1914 show a high degree of uniformity of employment. However, the maximum does not necessarily represent the total number of factory workers. At any time there is a certain number who are idle from choice, from physical incapacity, or from inability to obtain work in their own trade and habitat. The amount of this surplus, which, of course, must derive support from its several industries, is necessarily conjectural. If I assume that 90% of the factory workers are employed on the average I shall not perhaps be very far out of the way.

Similar conditions prevail in other districts. The builders suffer from a good deal of lost time. Coal miners, according to the statistics of the U. S. Geological Survey, work habitually only from 200 to 235 days out of the 305 to 310 possible in the year. Manifestly coal mining is a badly organized industry.* In 1917 the

*From 'The Annalist', of September 27, 1920.

*This was written in the early part of 1919. On November 1 began the general coal strike for a 30-hour week, and the public attention was drawn to the badly functioning nature of the bituminous coal mining industry. The prime trouble is deficiency in railway service, which perhaps results from antecedent economic evils. However, as conditions are now, and for many years have been, there are either more

average number of railroad employees, according to the report of the Railway Wage Commission, was 1,740,479, but in December of that year the number was 1,939,399.

Unemployment is a dreadful thing. There are some occupations that are necessarily seasonal, in which the wage-earner is expected to safeguard himself. There are others in which idleness results from industrial causes quite beyond his control, from causes beyond his employers' control. Some of our industries function badly, the mining of bituminous coal, for example. On the whole, however, manufacturing in the United States, if we may judge from the latest complete statistics (those of five years ago), shows no great variation in the number of persons employed month by month. But even so there is need for greater steadiness. The means for attaining it are not what the wage-earners think. They are not concessions to be wrested from the employing class, and yet it is just that class that is responsible, owing to its being the directing class. The wage-earners should not say: "Give us what you are keeping from us", but rather: "You are poor leaders; think how to direct us better." The means are purely economic and consist mainly in improving the transparency of industry, which will have the certain effect of minimizing ups and downs and maintaining a steadier course.

In comparing the incomes received by different classes of people it is obviously essential to consider the difference in living conditions, not only among occupations, but also among groups of people engaged in the same occupation. Thus the farm laborer neither requires so many things, nor do those that he does require cost him so much as the urban laborer. Consequently he is by no means so badly off as the statistics indicate. I computed in 1918 that a hired farm foreman who was receiving a cash wage of $50 per month and house rent and supplies that made his real wage $80 per month would have been obliged to earn at least $94 in the near-by city to be equally well off, and more likely would have had to earn $100. Miners are paid less in the copper mines of Michigan than in those of Montana, for it costs less to live there. Michigan miners attracted to Montana by the higher wages have found that they suffered diminution of net income and have returned to Michigan.

There are three elements in the production of wealth, namely, Labor, Capital, and Mind. In the controversy over the division of produce the latter two are commonly associated as the antagonist of Labor. The interests of Capital and Mind are, no doubt, the same, or about the same. However, there is a great difference in their position. Capital is to a considerable extent the accumulation of previous generations, inherited by the present possessors. Mind, on the other hand, springs directly from the ranks of Labor to a considerable extent. Especially in the United States is it always the case that a large proportion of the great directing minds are men of humble origin who have become capitalists by their own efforts.

Grouping Capital and Mind as the employing class, however, there is nobody who is averse from the promotion of the welfare of labor. It is merely a question of how much Labor, with the aid of Capital and Mind, can produce. There are certain demands of labor that the employing class should recognize in the common interest, and if it has been inattentive to them in the past that is ascribable to its own blindness. Working-places should be made safe and sanitary, representations of the workers respecting conditions should be considered, education should be encouraged, friendly attention should be given to the improvement of living conditions, including the checking of rapacity by landlords and tradesmen. All of these things should be done in the interest of enhancing efficiency and increasing production. Old-age pensions, insurance and maintenance during sickness are desirable, but can, of course, be paid for in no way except out of production, that is, by the wage-earner himself, and when done through the medium of taxation there is the assumption that the wage-earner's own thrift cannot be relied upon.

There are two specific demands of labor (other than the general demand for a larger share of the produce of industry) that are distinctly economic rather than sociological. One of these is for more considerate treatment as human beings, as for example in the shops of half a century ago, when the boss worked with his few men; even as squads of carpenters work in the country today. The realization of that desire would put the world back to the scale of living of fifty years ago. Men would not earn so much and they would not have so much. The old relationship has been sacrificed to Directing Mind, for the sake of the benefit of organization, and Labor has been paid for the sacrifice. It cannot eat its cake and have it too. Any such idea spells Bolshevism.

The other demand is expressed in two ways, namely, the right to work and the right to a wage commensurate with a decent standard of living. It may be flippantly represented that no man is deprived of the right to work, that any man may go into the fields and forests and find work to do, but practically he cannot, and the right to work means really the right of a man to work at his own trade. Associated with this is the minimum wage, which results from the confusion between money-wages and goods-wages. Neither the State nor the employing class can guarantee any standard of living. That depends solely upon what the wage-earners themselves produce.

The real gauge of the production of a country is not what is measured by dollars, but rather is what is measured by quantities. Unfortunately, reference is commonly made to the former owing to its being easier. The accompanying table shows the production of the principal commodities in the United States in 1916-1918 and enables some quantitative comparisons to be made.

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coal miners than are needed or else the production of coal could be greatly increased if the railways could carry it. There is manifestly a bad industrial situation here that should be corrected in some way, and probably could be corrected by leaders capable of thinking in terms of the industry as a whole. The coal miners themselves are the victims of bad leadership. Nothing that they can do by regulation of hours or rates of wages will improve their situation. The trouble is in the high command, not in the lower ranks.

Quantitative Comparison of Production of Principal Commodities in the United States in 1916-'17-'18

This table is compiled from the reports of the U. S. Department of Agriculture and the U. S. Geological Survey, the figures being reduced to the uniform basis of the ton of 2000 lb. and the following factors being used for conversions: Lumber, 1000 ft. b.m. = 2000 lb. Cotton, one bale = 500 lb. Corn 1 bu. = 56 lb. Wheat, 1 bu. = 60 lb. Oats, 1 bu. = 32 lb. Barley, 1 bu. = 45 lb. Rye, 1 bu. = 56 lb. Potatoes, 1 bu. = 60 lb. Apples, 1 bu. = 50 lb. Milk, 1 gal. = 8 lb. Poultry, average 4 lb. per head. Eggs, 1 doz. = 1.2 lb. Cement, 1 bbl. = 376 lb. Petroleum, 1 bbl. = 280 lb. While these factors may introduce some errors, the resulting figures are near enough.

Building Material	1916	1918
Lumber	79,614,502	65,520,000
Cement	17,205,985	13,363,352
Sand and gravel	89,091,732	61,802,694
Stone	91,831,000	80,000,000
Lime	4,073,433	3,028,000
Total	281,816,652	223,714,046
Fibres		
Cotton	3,184,250	2,925,000
Wool	144,295	140,960
Total	3,328,545	3,065,960
Cereals		
Corn	72,330,748	72,318,792
Wheat	19,196,480	27,513,000
Oats	20,027,372	24,613,699
Barley	4,070,857	5,768,437
Rye	1,326,724	2,494,884
Total	116,952,181	132,708,812
Other Agricultural		
Meat	10,384,250	11,683,000
Potatoes	8,608,590	11,703,030
Apples	10,229,150	9,868,000
Milk	32,012,000	33,716,000
Eggs	1,188,000	1,152,600
Poultry	1,134,000	1,178,000
Sugar	303,900	263,450
Tobacco	576,639	670,010
Total	64,436,529	70,234,090
Metals		
Iron	39,434,797	38,820,000
Copper	971,388	934,975
Zinc	680,018	525,122
Lead	592,241	550,729
Total	41,678,444	40,830,826
Fuels		
Coal—hard	87,578,493	98,826,084
Coal—soft	502,519,682	585,883,000
Petroleum	42,107,402	49,018,340
Total	632,205,577	733,727,424
Other Minerals		
Gypsum	2,757,730	2,056,462
Phosphate rock	2,220,271	2,789,651
Salt	6,362,906	7,238,744
Clay	2,932,590	2,810,000
Total	14,273,497	14,894,857
Summary		
Building material	281,816,652	223,714,046
Textiles	3,328,545	3,065,960
Cereals	116,952,181	132,708,812
Other agricultural	64,436,529	70,234,090
Metals	41,678,444	40,830,826
Fuels	632,205,577	733,727,424
Other minerals	14,273,497	14,894,857
Grand total	1,151,691,425	1,219,176,015
The hay crop	110,992,000	89,833,000

The table embraces the principal basic commodities. The chief omissions are beans, fish, vegetables used green or canned, fruits other than apples, flax, hops, hides, and sundry mineral products. However, the grand total comes pretty near to being the grand total of all the raw products of the United States.

These production figures agree closely with those of the Interstate Commerce Commission for the total tonnage of freight originating on the railways of the country, as follows:

Year	Tons
1916	1,000,000,000
1917	1,164,015,[illegible]
1918	1,[illegible]

Previous to 1916 the railway figures were given for fiscal years, which are not truly comparative. However, the figure for the fiscal year ended June 30, 1914, representing the twelve months immediately preceding the War, may be viewed instructively. In that year the total tonnage of freight originating on the railways was 1,000,460,330.

The railway figures should not correspond exactly with the production figures. Considerable freight is moved over rivers, canals, and highways. Many products, for example hay, are never moved off the property where raised. On the other hand, the railway statistics to some extent count the same products twice, for example, iron ore first and then the pig-iron made from it. Nevertheless, it appears that they are a fairly reliable index.

Returning to the production figures, it is manifest that they also must be viewed with qualifications. Here also there is duplication. Thus much of the hay and not a little of the cereal crops reappear in meat, poultry, milk, and eggs. Some products may be adulterated.

With such discriminating consideration, therefore, it may be safely deduced that during the three years 1916-'18 the production of building material decreased, the reasons for which are so well known that no further explanation is necessary. Fibres decreased a little. Cereals increased largely, for which again no explanation is necessary. There was also an increase in "other agricultural products", but in the production of hay there was a progressive and large decrease, which was a serious matter. Metals decreased a little, in spite of the strenuous efforts to maintain production. "Other minerals" increased a little, the increase in this case being due especially to salt and to phosphate rock (which may be connected with the agricultural increase). The most noteworthy increase of all was in the fuels.

Now in both cases—agricultural products and fuels—special conditions obtain. In agriculture there is far more elasticity in the capacity of labor than in mining, manufacturing, and other industries. The farmer who with his helper harvests ordinarily twenty tons of hay during the month of July finds no difficulty in mowing and storing thirty tons if an exceptionally good season gives it to him. In 1916 the yield of agricultural products according to my total (including hay) was about twenty-one tons per worker. The increase in the cereals and the decrease in hay in the following years *probably* occurred without there being any material change in the number of workers, and the tons per man *probably* varied a great deal.

It is important to note that whereas the agricultural produce in 1916 was only about 21 tons per worker the output of minerals was nearly 1100 tons per worker. This reflects the difference between a slightly mechanicalized and a highly mechanicalized industry.

The increased production of cereals and fuels was chiefly, perhaps wholly, demanded by conditions of the War—cereals to feed Europe, the fuels for extraordinary war-time movements.

It is sufficiently clear from this reasoning, rough though it be, that the increase in American commodities

from 1916 to 1918 was wholly attributable to those in the production of which there had previously been much lost time. If these be deducted from the grand total it will appear that in all others output was either at a standstill or diminished. In other words, there was a smaller supply of goods to be divided among the people, although the number of people increased, the population of the United States being estimated at 99,027,000 in 1914, 100,725,000 in 1915, 102,431,000 in 1916, and 104,145,000 in 1917. An estimate for 1918 would be about 106,000,000. In spite of the draft of men into the Army and the Navy, the increase in population, together with the employment of women in increasing numbers and the impressment of previous idlers, which probably maintained and possibly increased the working population, the latter was either unable or did not choose to increase production after 1916.

There is thus a good deal of reason to believe that the output of minerals, metals, and manufactures in tons per man declined from 1916 to 1918, and that high wages, instead of being a stimulus to increased production were a direct inspiration toward increased loafing. Many men who previously had to work 48 hours per week in order to get their living worked only 32 hours when they became able to obtain sufficient in that time. It may be conjectured that production would have declined more seriously during this period if managerial efficiency, strained to its utmost, had not offset the slacking by the workers. Even as between the 10-hour day and the 8-hour day in normal times, it is doubtful whether the assertion that workers can (or will) produce as much in eight hours as in ten be not a fallacy. Anyhow, it is a debatable question. All of these conditions deserve more study by the methods of a broad survey than has yet been given to them.

This study, incomplete as it is, reveals certain things that are positive. The workers of the country in 1916 could have added but slightly to their income if they had confiscated the entire share of Capital and Mind in the national produce. Since 1916 Labor as a whole has not benefited, for the national produce has not increased in quantity, on the whole, and a large part of it has been wasted for warfare. We have got along as well as we have only by the use of previous accumulations of goods and failing to do things that are necessary for the comfort of the people, such as improving transportation facilities, adding to housing capacity, etc. Instead of the American people as a whole having risen to a higher plane of living than before the War, they have descended to a lower.

Some classes of labor have profited, to be sure, but that has been wholly at the expense of other classes of labor. The taxpaying classes suffer diminution of net income, but, even so, they retain enough to satisfy all material wants in shelter, clothing, and food. Not so with the less fortunate among the working classes. They are deprived of the full measure of shelter, clothing, and food that is necessary to maintain a high standard of living. The taxpaying class is deprived, in the main, only of the former ability to save, and that in itself is to the disadvantage of the working classes, for it was just those savings that used to build railways, houses, etc.

It has been shown in this study how wide are the variations in the average income of the working classes. The agricultural worker in 1916 got only $400. The factory worker, $675. The railway man, $886. The metal miner, $1250. It is impossible to ascertain the average earnings of builders, clerks, and shopkeepers, but probably they were in the superior ranks.

Among the major classes themselves there are wide variations. Thus railway conductors and locomotive-drivers receive high wages, while the track hand gets low wages. Similarly, in the steel industry the metal roller is relatively a plutocrat, while the yard laborer receives only a pittance.

I think that it has been made clear that when a group of workers, like the railway workers, whose uninterrupted service is indispensable to the life of the people, band together, take the people by the throat and exact higher wages, which means the right to command more goods, they do so at the expense of all other workers. When the steel workers say that they demand wages that will afford them a high standard of living, they say in effect that they want to get that for themselves, and do not care what happens to the clerks and factory workers. It will be the realization of this, I think, that will eventually disrupt the American Federation of Labor, just as the Knights of Labor disintegrated in the 'eighties.

That America will become Bolshevist is not to be feared. If any such fear be entertained, the thought that the corporations of the United States are mainly owned by people of moderate incomes, and that about one-third of all our workers are agriculturists will dispel it. A fault in most discussions of this whole subject is the absence of perspective, the appreciation of the huge number of our workers, and how what seems to be only a few dollars for the individual means billions in the aggregate. It has been the purpose of this study to furnish a perspective.

The economic lesson is, of course, simply that there must be more production and less extravagance. In no other way can the standard of living be improved. The idea of increased production cannot be reconciled with the idea of the six-hour day and the five-day week. Increased production can only be expected as the result of more work and harder work; and by improved organization by the captains of industry.

It may be asked: If the return on the capital of the country is relatively so small as has been indicated herein, why is it that some corporations realized such phenomenal profits in 1916? It is precisely those profits upon which the attention of the dissatisfied is focussed and prompt the question why should profits in some cases be as large as the total payroll and the outcry that there is something manifestly unfair in that.

The answer is that such corporations are relatively few and the aggregate of their swollen earnings is relatively small in comparison with the grand total. This may be grasped when it be considered that the dividends of all corporations in 1916 were less than $4,000,000,000.

But how are the few excessively profitable corpora-

tions to be treated? Suppose there be an industry employing 10,000 men who earn an average of $1000 per annum. Suppose there be one company in that industry that employs 100 men by virtue of superior management, location, the possession of rich raw material, etc., earns a profit of $1,000,000, which is 50% on its capital, while all the other concerns in the industry earn from 10% at the maximum down to nothing at all. The rich concern could afford to pay higher wages, but if it did so what would be the situation in the rest of the industry? How would participation in profits work out in such a case and why should participation in profits be granted to persons to whom they were not due, the assumption here being that they were due to managerial excellence? If the men working in the no-profit factories should by the exercise of increased diligence and intelligence produce a profit, the management remaining the same, a participation in it would be reasonable, but that idea is not commonly expressed.

The matter of very great profits is capable of several developments that are more or less sound economically.

1. They may be commandeered by the State as excess profits taxes, the burden of taxation upon the bulk of the people being correspondingly reduced. There is always the danger that such a levy will be made so severe as to destroy incentive, in other words, kill the goose that lays the golden egg. However, within limits, such an equalization of profits may be effected.

2. Increase the transparency of industry, so that competition will tend to reduce excessive profits. Manifestly, if the profits of the industry that I have cited were more equally divided, labor could demand and would get higher wages. I believe that this is the true economic solution of the great problem of the time. Labor would gain and capital would not lose.

3. Exterminate the less efficient concerns in an industry and concentrate production in the big economical corporations, which can afford to pay increased wages. Some of the thoughtful among the labor leaders are supposed to have indorsed such a program, although it means practically nullification of the anti-trust laws. This may be economically defensible, but the idea of putting great industries absolutely into the hands of big corporations co-operating with big labor unions is abhorrent.

I think it is obvious that the second of these thoughts is inherently the soundest, but owing to its abstractness it may not readily be grasped. Yet reflection upon it will show that it holds forth the real remedy for many economic and social evils. It may be suggested that a combination of the first and second would be wise, but I do not think so. Taxation upon consumption is more rational than taxation upon production.

However, any program may lead nowhere if there be absence of understanding of what is to be divided. That which is to be divided is not money, but goods. Taking the industry that I have suggested, and let it be supposed that it was engaged in the manufacture of shoes, elevation of the industrial plane might result in three ways.

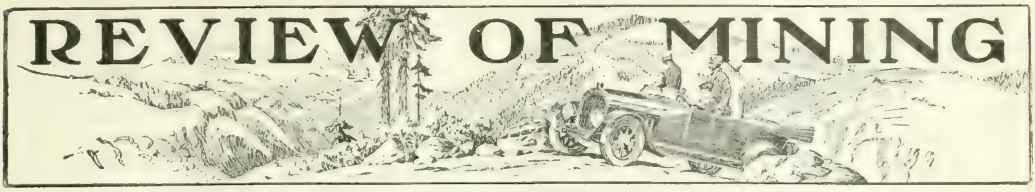
1. The 10,000 men engaged in the industry might make all the shoes necessary by the labor of six hours per day instead of eight and decide to work only six. Then they would have more leisure, but if the time gained were idled away nobody would be any further ahead than he was previously. There would be no increase in the standard of living for anybody.

2. It might be found that instead of 10,000 men being required, 8000 could make all the shoes needed, and 2000 could be diverted to the manufacture of something else that was wanted.

3. The output of shoes might be increased and the surplus sold to some other community in exchange for some of its goods. The second and third are the only ways whereby labor can participate in the profits of industry and benefit therefrom.

According to Edwin N. Gunsaulus, U. S. Consul at Singapore, the imports of tin and tin ore into the Straits Settlements during 1918 were 85,000 and 1,059,000 piculs (1 picul = 133⅓ pounds), respectively, and the exports of tin 925,000 piculs of a value of $81,546,038, of which the United States took 578,000 piculs of a value of $51,070,145. For 1917 the imports into the colony of tin and tin ore were 107,000 and 1,240,000 piculs, respectively, and the exports of the refined product 1,076,000 piculs, worth $66,898,601, of which 392,000 piculs, worth $24,607,162, was exported to the United States. Although the total exports of tin in 1917 exceeded in quantity those of 1918 by about 151,000 piculs, the value of the 1917 exports was less by $14,647,437 owing to the exceedingly high prices received for the metal in 1918. The imports of tin into the Straits Settlements, as distinguished from tin ore, represent the output of small smelting plants operated by the Chinese in the Malay States, also shipments from European smelters at Penang, which are almost exclusively for transshipment at Singapore. In addition to the above a small quantity of slab-tin (unrefined) is received from Siam, for transshipment to China. The relative quantity of refined tin imported, compared with tin ore, is small, this being accounted for by the fact that the tin-smelting concerns in Singapore and Penang are in position to handle the ore more advantageously than the average mining company.

The borax or tincal deposits occurring in Tibet were probably the first borates ever utilized. About 220 tons is exported annually from India, and this, which is practically all obtained from Tibet and Ladakh, is imported across the frontier into the Punjab and United Provinces. Herds of sheep and goats may be met in the Himalayan passes coming down from Tibet in the spring, each carrying two small bags of borax or salt to be bartered for Indian and foreign stores. The material exported from Tibet is obtained from salt lakes which have possibly obtained their borax from volcanic sources. The borax obtained from the Puga valley of Ladakh, Kashmir, is deposited from hot springs associated with sulphur deposits, which are regarded as evidence of waning volcanic action.



FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

PHELPS DODGE STOPS OPERATIONS ON SACRAMENTO HILL.

KINGMAN.—Development work is in progress on the property of the New Comstock Mining Co. The main shaft is to be continued to a depth of 700 ft., and the vein thoroughly explored to that depth. The mine is being developed at present on the 300 and 400-ft. levels where good bodies of mill-ore have been developed. Operations at the Swansea mine, which were stopped a few months ago by a strike, are again in progress, with 120 men at work. The property is under lease to the operators of the Humboldt smelter, and the ores are being dressed and shipped to that plant. The company is reported to be interested in a project to develop water-power by the construction of a dam at the Bill Williams fork. An important strike of ore is reported on the Tom Reed property, in the east drift of the Aztec mine, about 200 ft. from the west end-line of the American. The drift has been in the orebody for a distance of 60 ft., samples averaging about $40 in gold, with some higher.

TUCSON.—F. L. Ransome, who is in immediate charge of geological work in the metal-mining districts, under the U. S. Geological Survey, will be at Tucson next month to confer with mining men about a survey of the Papago mining district. He probably will make a preliminary study of the Pima and Papago districts.

TOMBSTONE.—The Solstice Mining & Milling Co., with offices in Bisbee, has made a contract for machinery totaling more than $10,000 and will begin active development work as soon as it can be erected. The company has been financed for $50,000 by a Chicago bonding company.

BISBEE.—Notices have been posted by the Copper Queen Branch of the Phelps Dodge Corporation in Bisbee to the effect that a number of men will be laid off at the Sacramento Hill property on November 1. The reasons given are that materials for carrying on construction of the new mill are delayed and that the company has not sold any copper since March 1. The management further stated that $13,000,000 had been expended since the first of the year in construction and operation and it was necessary to stop all unnecessary expenditure. The Solstice Mining & Milling Co. was recently financed by a Chicago bonding company for $50,000, thus making possible the order just placed for $10,000 worth of machinery to carry out sinking and other exploration work.

During the past week the major portion of the business section of the town of Lowell was destroyed by fire, which also threatened the mine office of the Calumet & Arizona Mining Co., at the Junction shaft. Estimates have placed the total loss at over $750,000. In the early part of this year an electric mechanical shoveler was tried out in the Junction mine of the Calumet & Arizona Mining Co. This machine was used only in headings in the driving of drifts. During the first trials there was naturally considerable loss of time due to numerous mechanical defects which had to be overcome. In the late spring another type of shovel, operated by compressed air, was experimented with; in general it was found much easier to keep in continuous operation than the electric shoveler. A large type of shovel has been used at Inspiration for several years, the work being entirely in large headings. Recently, these have been replaced by smaller shovels operating with compressed air. The smaller shovel is much more convenient, is more easily moved, and has not the large amount of complicated machinery to be taken care of, which forms a part of the other machine.

AJO.—From a concession recently given the New Cornelia Copper Co. to build a railroad from the international line to the Gulf of California, thorugh northwestern Sonora and north-eastern Lower California, Bahia de Roca (Rocky Bay) appears to have been determined upon as the tide-water terminus for the proposed Ajo-Gulf of California railroad. This indicates that a bridge will be built across the mouth of the Colorado river, well within Mexican territory, for the bay is an indentation of the western gulf shore. It is now proposed also to build a direct automobile road from Ajo to one of the two eastern ports named, and a survey of the route now is in progress. There is assurance that the Mexican end of the road will be built through the famous Altar mining district by the Mexican government.

MAYER.—The Arizona Binghampton, one of the largest mines in the Mayer district, has closed down temporarily owing to the present condition of the copper market.

JEROME.—Steam-shovel operations west of the former office building of the United Verde mine have opened up an orebody 75 to 100 ft. wide in the black schist. It is said that the ore runs more than 4% copper and that some of the ore contains as much as 15% copper. This body of ore was exposed in an old drift and has been known for some time but has never been developed or worked. Present exposures do not show how large the orebody is. Two of the three shifts employed in sinking the Jerome-Superior shaft have been laid off. The reason for the reduction in force has not been given.

MIAMI.—J. Klinfelter, G. J. Berthold, P. Sullivan, B. Flood, and S. Sutton, claim owners in Lost Gulch, have filed suit for $500,000 against the Inspiration-Miami Copper Co., Inspiration-Miami Extension Copper Co., and the Globe Copper Co. The plaintiffs claim that the defendants, under the name of the Inspiration-Miami Copper Co., agreed to pay $400,000 to them for a group of claims, which sum has never been paid. They further allege that the personnel of the three companies is the same and that the three companies were used to transfer stock and properties back and forth in such a manner as to defraud the defendants.

COLORADO

VANADIUM FOUND NEAR TELLURIDE.

ASPEN.—A power-line has been extended to the Hope tunnel and a full force is again working in the heading. Supplies have been laid in for continuous winter operation. The Turley tunnel in the old Ashcroft district, 15 miles south of Aspen, projected to cut the rich Tam O'Shanter vein, has been financed by Aspen operators. The tunnel will intersect the Tam O'Shanter approximately 2500 ft. below the surface. Six other veins, one the Michigan, and an immense fault, believed to be the centre of rich mineral deposits, is in due line with the survey course of the tunnel. The Aspen Silver Lead Mines has started construction on a power-line from Meredith to its property on Porphyry mountain.

BRECKENRIDGE.—Increased freight-rates have resulted in curtailment of mill and mine operations by the Wellington Mines Co. The increase, amounting to $2.50 to $3.75 per ton, would cause loss, and one of the biggest zinc-producing mines in the State and the largest employer of labor in Summit county is expected to cease production soon. The pumps, however, will be kept in operation and a small force kept at work on development. Efforts of the management to secure a fair rate on concentrate and ore shipments to date have failed. Bulkeley Wells and associates have ceased operations on the Iron Mask and pumps have been pulled, development in the lower workings failing to warrant continuation. The upper level has been leased. Remaining equipment for the Laurium mill of the Blue Flag company has been shipped and as every preparation has been made for immediate installation, it is expected the plant will be in operation early in November.

CRIPPLE CREEK.—October production of the Modoc Consolidated Mines Co. will approximate 2700 tons of ore with an average value of $30 per ton. This increased output, which brings the company into the front rank of district producers, is the direct result of the discovery about 7 weeks ago at the 1300-ft. level. Here the southeastern extension of the Orpha May-Ruby-Last Dollar-Modoc system has been proved and an orebody averaging between 25 and 27 ft. wide, in places 42 ft. between walls, has been opened up for 120 ft. in length. Stoping has started and ore shipped to date has averaged $30 per ton. M[illegible] hoisting machinery is under construction for the No. 2 or Last Dollar shaft of the company and with the new plant in commission and miners available 3000 tons monthly can be mined and shipped. The No. 2 shaft of the Portland Gold Mining Co., on Battle mountain, has attained a depth of 2450 ft. and a station is now being cut at an elevation of 7794 ft., the deepest working in the entire district. Ore mined at the level above continues high-grade. Settlement on a carload shipment from the Hardwood, Ironclad hill, property of the United Gold Mines Co. made last week was at the rate of $155 per ton. The lessees shipped another 40-ton lot this week estimated at between 8 and 10 oz. gold per ton.

Drilling has commenced on a second diamond-drill hole at a site selected on Galena hill, about three-quarters of a mile north-east of Cameron. The new hole will be drilled at an angle of 45°. The Bolivia and other phonolite dikes have been opened in shallow workings in this section and it is expected mineralization will be found in the drill-core that will warrant development. The first test drilled to 1386 ft. showed mineralization below the granite capping.

LEADVILLE.—Not only has the authorized increase in freight-rates been cancelled through the efforts of the Leadville Chamber of Commerce, but in addition the American Smelting & Refining Co. has been induced to cancel its recently announced increase in treatment charges on certain low-grade ores and to reduce charges on all ores with less than $10 net smelter return that contain less than 35% excess insoluble, and similar ores with more than 35% insoluble if the content does not exceed 2½% sulphur. The announced reduction materially benefits the smaller operator and lessee. Sinking is in progress under contract at the Blain shaft and production is maintained at 25 tons daily of 25% zinc ore. A more powerful electric hoist has been put in place and with the shaft at the 350-ft. level, increased production is expected.

A promising zinc orebody has been opened up by lessees on the Lilian in Iowa gulch. Ore-bins are being constructed. Lessees on the A. V. within the city limits have several hundred tons of a good-grade manganese-ore ready for shipment and awaiting cars.

TELLURIDE.—The Valley View Leasing & Mining Co. is mining good ore at Matterhorn and the mill is running steadily. A three-car shipment of concentrate was consigned to the Durango smelter last week. Vanadium-bearing rock has been found in the white cliffs less than half a mile from the city limits. A test made by the Colorado Vanadium Co. showed high vanadium content and the company's engineer is on the ground making locations. Many claims have been staked.

MICHIGAN

LABOR SITUATION IMPROVING.

CALUMET.—Geological research work which the Calumet & Hecla began a year ago is progressing, but because of the volume of work necessary it may be a year or [illegible] before any definite conclusions are drawn. An effort

will be made to determine, if possible, the origin of native copper and the processes by which it was deposited. If this result can be attained it will greatly simplify the work of finding new copper deposits. Samples are being taken from various veins of the Keweenawan formation and the results of the analyses will be correlated in the hope of evolving dependable rules for use in exploratory work. The survey is of interest to every mine in the district, for if it is successful the information will be available to all.

An improvement in the labor situation, reported by Mohawk, is one of the most encouraging developments recorded in the Lake region in many weeks. While not large, it is sufficient to indicate that the labor problem is disappearing. Mohawk has a market for its copper and if it can get men enough it will proceed with the development of the fissure which appeared most promising on the 22nd and 23rd levels of No. 4 shaft. Because the entire force is needed for regular operations, it has been necessary to temporarily suspend the opening up of this vein. The fissure was first encountered about 1400 ft. south of No. 4, on the 22nd level, and openings in the foot and hanging wall revealed it to be well charged with heavy copper. The same showing was noted on the 23rd, where the fissure was about 100 ft. closer to the shaft, and in addition to heavy copper, 'mass' was found. Contiguous to this fissure the main vein has widened out to the abnormal depth of 40 ft. in some places, and this so-called 'wide spot' has been opened down to the 24th Mohawk's No. 1 shaft, temporarily idle, which will come into its own again with the restoration of normal conditions. Much ground remains to be mined by this shaft, which has approximately 900 ft. more to go before it reaches the property limits.

Seneca has completed the concreting of its shaft and by the end of the week will have removed the forms, permitting the completion of the cross-cut to the vein on the 5th level. Drifting then will be pushed and the level opened north and south. On the 4th level the south drift has reached the boundary, while the north drift is 725 ft. long. The north drift on the 3rd level is 790 ft. long and, like the 4th, is breasted in ground that compares favorably with any opened heretofore. Seneca is making irregular shipments to the Baltic mill instead of letting the 'rock' accumulate on the ground. For the present the management will content itself with development work instead of production.

Figures revealed in the annual report of the Houghton county inspector of mines are somewhat startling, for they show that during the past year the combined forces of all of the mines in the county numbered only 6083. This compares with 7865 in 1919 and 16,423 in 1917. The fact that a marked improvement has been noted during the past four weeks, however, is reassuring. The Calumet group alone reports a net gain of 60 men per week. The county figures do not include Ahmeek, Mohawk, Allouez, or the mines south of Champion. A curtailment of operations in the automotive centres accounts for the betterment in the labor situation here.

Mayflower's south drift still continues in good vein matter, though the mineralization is not as heavy as a week ago. It is the plan to continue the explorations on the 1700-ft. level so that portion of the mine will be thoroughly opened before attempting any work of an extensive nature on the 1400-ft. level. It was in the latter that the Mayflower lode was originally uncovered.

NEVADA

THE NIVLOC NORTHERN MINES CO. ORGANIZED.

COMO.—Gurney Gordon, general manager of the Como, in giving his reasons for closing the mines, says in a statement to stockholders: "We feel that it is not profitable to operate a producing mine under present conditions. The miners are not satisfied with the present wage-scale and we cannot pay more because of the general low

MICHIGAN COPPER DISTRICT

efficiency of labor. We have hoped for a reduction in the price of supplies for the last two years, also for improved labor conditions, but they have grown worse every month. We feel that it is not good policy to deplete our ore-reserves further under these conditions, for, using as a basis the purchasing power of money five years ago, we can only figure the value of our gold at $8 per ounce and silver at 40c. per ounce at the present time." The Como was paying the Virginia City wage-scale. The statement says the increased price of powder, lumber, and lime since January 1, 1920, has added $1500 monthly to the operating costs. There is $2,500,000 worth of $10 to $12 ore blocked out in the mine, according to the statement. This is being treated in a 100-ton mill.

TULE CANYON.—The Silver Hill company, operating the Ingalls under option, has stopped all work that was being done by contractors. This was the result of a tele-

gram from W. J. Loring, ordering the work stopped until "after election", according to one of the contractors. The mill is not working on ore, but tailing is being retreated with cyanide.

Virginia City.—Miners employed in the North End mines have been notified by Alex Wise, superintendent, that the $5 wage-scale paid before the strike early in September will become effective again on January 1. Since the strike the scale has been $6. This will be done, according to the manager, so that other companies, unable to operate under the advanced scale, can resume. He says that in view of general declining prices the $5 scale "will work a hardship on no one and will create at least four or five times the present opportunity for employment".

West Divide.—A two-drill compressor is in use at the West Divide, L. L. Patrick, manager, an ore-bin has been built and is being filled, and new buildings have been completed. A drift is being driven north on the main-tunnel level in a vein parallel to that in the shaft and short cross-cuts are being driven as the drift is advanced. The north drift on the 65-ft., or shaft-level, also is being continued. The ore-shoot, after having been only a few inches wide for a distance of 12 ft. at this depth, is widening. Assays of as high as $1900 in silver and lead have been secured recently from two and three-inch widths. Then men are employed.

Silver Pick.—The Nivloc Northern Mines Co. has been organized to further develop 15 claims formerly owned by the Nivloc Mines Co., eight miles south-west of here. Officials of the company say a 100-ton mill is to be built to treat $10.50 ore. A. G. Cummings, formerly in charge of the Nivloc, is the organizer and manager of the new company, and associated with him are Fred Remick, formerly superintendent for the Montezuma Silver, Henry C. Schmidt, John M. Cotton, and John R. Cunningham. The ore, in quartz veins with limestone walls, is said to be free-milling. The main work is done through a 420-ft. shaft, from the bottom of which a cross-cut penetrates four veins of a total width of more than 100 ft. Practically all of the work is on the bottom level. About 300 ft. of cross-cuts and an equal amount of drifting have been done on that level and one raise has been driven a short distance. More than $300,000 has been spent in development.

Goldfield.—George Meuli, a Lone Star lessee, has completed in a Gibson mill a trial run of 25 tons of $200 ore. Practically all of the free gold was saved by amalgamation, but the loss in telluride is estimated to have been $25 per ton. The tailing may be treated with cyanide at the mill or it may be shipped.

Montezuma.—The Washington Montezuma, after being idle since 1914, has resumed work. An 18-hp. hoist, 32-ft. head-frame, and five buildings have been erected. Montezuma is a silver-lead district, but the Washington ore contains gold only. Assays as follows have been obtained in a 200-ft. shaft: 4 ft., $11; 10 ft., $22.10; 10 ft., $150. A drift has been driven 140 ft. from the bottom of the shaft and it is now being extended. Later it is planned to sink the shaft deeper. The company owns two claims. The vein, quartz with limestone walls, is 45 ft. wide at the bottom of the shaft. The officers, all Chicago men, are R. H. Kiehm, president; John J. Sullivan, vice-president and manager; Gustav Schulz, treasurer; John M. Zamecnek, secretary. Sullivan is a police sergeant making his first venture into mining as a manager and, without assistance, he has done well so far.

Pioche.—No action has been taken as yet by the officials of the Salt Lake Route toward reducing freight-rates on ore shipments, although promises and assurances have been made to the larger producers. During the week ending October 16, the Prince Consolidated shipped 1510 tons; Virginia-Louise, 515; Bristol Silver Mines, 150; Black Metals, 100; Combined Metals, 55; Currency Lease, 40; Zero Lease, 40; making a total of 2410 tons.

UTAH

'SPECIAL CONTRACTS' DECLARED DISCRIMINATORY.

Salt Lake City.—The U. S. Bureau of Mines has allotted $27,000 for co-operative experimental work at various institutions in Utah, and has allotted $7500 to the Idaho Bureau of Mines and Geology. These sums must be matched by State contributions. On October 19, the Public Utilities Commission of Utah handed down a decision in the so-called 'special contract' cases, involving the Utah Power & Light Co.'s schedules for power service in this State. These special contracts allowed 56 of the largest customers a rate for current considerably lower than that paid by other customers receiving similar service. The investigation was begun on September 27, 1919, when an order was issued by the Commission, stating that the special contracts were "discriminatory and preferential". The initial hearing was begun on December 8. The metal-mining companies involved include the United States Smelting Co., American Smelting & Refining Co., Silver King Consolidated Mining Co., Utah Copper Co., and other prominent coal and metal-mining companies. These companies are placed, for the time being, on standard schedules. During 1919, the total earnings of the Power company were $4,431,846, of which amount the special contract holders contributed $1,781,434. Under the decision, the special contract holders will be called upon to pay approximately a million dollars additional per annum for their current. The Utah Copper Co. alone, in some years, has consumed more than one-half of the Power company's output. The contract rate per kilowatt hour is 4.8 mills, and the standard schedule for such service is 8.2 mills. The Power company contended that it was furnishing power to the Utah Copper at about 40% of the actual cost of such power. The special-contract holders contended that a contract, lawful when made, should, under the constitution of both the State and nation, be held inviolable from interference by legal authority. On October 21, attorneys for several of the mining companies filed petitions asking for a re-hearing of the case.

Gold Hill.—Exploration work at the Success mine, about four miles from here, is meeting with conditions which promise well for the future of the property as a producer, according to S. M. Fleming, who is in charge of the property. On the 200-ft. level, for a distance of 350 ft. along the strike of the vein, an average of two feet of silver-lead ore, valued at $30 per ton, has been opened up. This ore, it is stated, extends to the surface. A carload of carbonate ore, mined on the surface, is ready for shipment. The vein, which traverses the granite-limestone in a north-south direction, has been developed by an inclined shaft sunk on the dip of the fissure. The mine has been equipped with modern machinery by the owners of the property, George Peters & Sons of New York City.

Bingham.—On October 20, Federal Judge Tillman D. Johnson handed down three decisions in the six cases pending between the Utah-Apex Mining Co. and the Utah Consolidated Mining Co., whereby five of the suits were decided in favor of the Utah-Apex and one in favor of the Utah Consolidated. R. H. Channing, Jr., president of the Utah Consolidated, states that his company will at once move to take the cases decided against it to the United States Circuit Court of Appeals.

Alta.—An assessment of 1c. per share has been levied on the stock of the Howell Mining Co. The levy is delinquent November 16. Recently the company was granted permission by the State Securities Commission to sell a block of treasury stock at 10c. per share. The Alta Tunnel & Transportation Co. has awarded a contract for 200 ft. of work in the east drift from the Alta tunnel, according to F. V. Bodfish, manager. The drift is following one of the Prince of Wales fissures through a broad zone of the brecciation of the type in which have been found the orebodies of the Emma and other Alta mines. The drift is now 600 ft. below the bottom of the Prince of Wales shaft. The company has completed the construction of a new power-line to Big Cottonwood canyon, which should ensure continuous power throughout the winter. A new and shorter road to the property has been finished, which will expedite the handling of material to and from the mine.

Park City.—A body of iron sulphide, in which bunches of good copper-silver ore occur, has been found in a drift from the Spiro tunnel in the Silver King Consolidated mine, about seven feet from the tunnel. Some of the ore assayed 9% copper and 13 oz. silver. Samples of gray copper from one of the other fissures encountered by the Spiro tunnel gave assays of 128 oz. silver and $32 gold per ton. A feature of the iron-sulphide development is the fact that all of the approaches to the Parsons stope in the upper workings of the mine, from which approximately $1,500,000 worth of ore was taken, passed through heavy iron sulphides. Present operations are being financed by the sale of short-term convertible 7% notes. The notes are convertible into stock on a basis of $2 per share. The company's last annual report showed that receipts from the sale of these notes during 1919 totaled $128,200. Shipments of ore from six mines in this district for the week ending October 16 totaled 1832 tons, of which the Silver King Coalition shipped 519; Judge M. & S., 401; Daly West, 353; Ontario, 376; Keystone, 83; Naildriver, 60. The Judge smelter shipped 40 tons of premium spelter.

OFFICE OF THE PHELPS DODGE CORPORATION AT TYRONE, NEW MEXICO

Operations at the electrolytic smelter of the Judge Mining & Smelting Co. were suspended on October 22, as a result of the decision of the Public Utilities Commission to allow the Utah Power & Light Co. to increase power-rates. The Judge company is one of the holders of 'special contracts' for power service. The low price of spelter and increased mining and refining costs make operations of the smelter inadvisable and unprofitable, according to G. W. Lambourne, general manager.

The new milling-plant of the Keystone Mining Co. is

about 80% complete. A crushing-plant of 100 tons daily capacity will be erected. Officials of the company believe the new plant will be ready for operation soon after the first of the year. By an agreement with the Silver King Coalition, the Keystone company has been using the Hanauer tunnel for the purpose of developing its property, and several ore showings have been opened up during the past year. By using this tunnel, the Keystone company was able to do development work at a depth of 800 ft. below the deepest of the old workings.

Eureka.—Preparations are being made to resume work at the property of the Diamond Queen Mining Co., about 3½ miles south of Silver City. Buildings have been erected and the necessary equipment purchased. A connection was recently made with the Silver City water system to supply the necessary water. The shaft will be deepened; a hoisting equipment good for a depth of 1000 ft. is now being installed. An assessment was recently levied on the outstanding stock of the company, the proceeds of which will be used for the development.

Shipments of ore from this district for the week ending October 16 totaled 123 cars, of which the Chief Consolidated shipped 37; Tintic Standard, 27; Mammoth, 14; Dragon, 13; Iron Blossom, 7; Grand Central, 6; Iron King, 4; Centennial-Eureka, 3; Eagle & Blue Bell, 3; Swansea, 2; Victoria, 2; Gemini, 2; Bullion Beck, 2; Colorado, 1.

A contract has been let by the East Crown Point Mining Co. for sinking a main working-shaft, according to Charles Zabriskie, manager. The shaft is being sunk for assessment work. George Adams, who is in charge of the development at the property of the Dagmar-Northwest Mining Co., reports that the sinking of the shaft will be resumed. It is now 190 ft. deep and it is the intention to continue sinking until the 500-ft. level is reached, when drifting will be commenced.

High-grade streaks and bunches of ore are appearing in the face of the drift on the lowest level of the Eureka-Lilly mine, which is 1600 ft. below the surface, according to Grant Snyder, manager. Work is progressing in a satisfactory manner on the foundations for the machinery at the South Standard property, according to E. J. Raddatz, president. The shaft at this property will be one of the largest in this district, having four compartments; one compartment being used solely for ventilation purposes. A power-line has been erected between Tintic Standard and the South Standard properties. While most of the work at the old Centennial-Eureka mine is being handled by lessees, the company is also doing considerable prospecting and shipping some ore. The company owns a few claims adjoining the Mammoth mine, and a drift is being driven for the purpose of prospecting this ground.

BRITISH COLUMBIA

HIGH-GRADE ORE BELOW PRESENT WORKINGS IN THE DOLLY VARDEN.

Usk.—Considerable activity in prospecting continues to be shown in this district, although the season is rapidly drawing to a close, snow already having appeared on the hills. A promising 10-ft. belt of ore is being developed at the Silver Horde group, at the head of Chiminess creek. The orebody contains numerous stringers of gray copper, varying from the thickness of a sheet of paper to a foot in width. Recent assays of culled ore have run 15 to 20% copper and 200 to 300 oz. silver per ton. The Kleanza Mining Co. has been finding some rich gold ore on its No. 5 claim; assays have given as much as 4 oz. in gold and 15% copper.

On Bornite mountain, three miles from Usk, the Hazel group is being developed with promise of a successful outcome. The ore is chalcopyrite and bornite, with a small quantity of gray copper. Specimens have been assayed with returns of 28 oz. silver, 24% copper, and 0.10 oz. gold. Tunnel operations are to be started on a vein about five feet wide of mixed high-grade and milling-ore. There is a large mineralized dike in this section which has been cut by Emma creek and by the action of the water the ore was exposed. From the Peerless claims of the same locality was taken a specimen that weighed over 100 lb. and is estimated to contain 50% copper. Epidote and hornblende form the matrix of the vein from which this was taken. It has been stripped for over 100 ft. and several deep cuts made, the result being the uncovering of 26 in. of high-class ore, the remainder for a width of 7 ft. being milling-ore. There is one hundred tons on the dump for shipping and plans are being made for the resumption of operations next season on a large scale. There is a force of fifteen men at work on the Kitselas Mountain Copper Co.'s property, also near Usk. North and south drifts respectively are being driven on No. 1 and No. 2A veins and a foundation of concrete is being laid under the mill and so extended as to provide for an addition when one is required. The concentrates coming from the chalcocite and bornite ore are high-grade, giving returns of 48% copper, 40 oz. silver, and 2.20 oz. gold per ton.

Trail.—Despite the fact that little ore is reaching the smelter from the Sandon and other Slocan camps, the total received each day has been mounting gradually, and recently has averaged well over 1000 tons. During the first 14 days of October, 16,033 tons was received, the Consolidated M. & S. Co. mines contributing 13,669 tons. The other shippers were: Bell, Beaverdell, 41 tons; Bluebell, Riondel, 157; Emerald, Salmo, 33; Florence, Princess Creek, 133; Granby, Grand Forks, 107; Iron Mask, Kamloops, 53; Josie, Rossland, 627; Monarch, Field, 42; North Star, Kimberley, 343; Ottawa, Slocan City, 30; Paradise, Lake Windermere, 47; Rambler, Cariboo, 43; Ruth, Cedar Creek, 118; Silver Bell, Zwichy, 44; Spokane-Trinklet, Ainsworth, 39; San Poil, Republic, Washington, 228; Skyline, Cedar Creek, 53; Venus, Yukon, 54; and Wellington, Beaverdell, 80 tons.

Hazelton.—James Cronin, manager of the Babine Bonanza, has announced that the cross-cut has reached its objective and has penetrated a 12-ft. orebody, but that until proper machinery to facilitate mining has been erected no further work will be done on the vein.

From now on the whole force will be occupied in getting ready for and erecting machinery. J. S. Kelley, who is developing a 3-ft. vein at the Judge group, Babine range, has been taking out ore recently that assayed up to 100 oz. in silver. It also contains some copper.

Prince Rupert.—High-grade ore, similar in character to that obtained in the present workings, has been penetrated 500 ft. below the present workings by a diamond-drill at the Dolly Varden mine. This has greatly encouraged the owners of the property, as it fairly well establishes persistence to that depth, at any rate. No assay of the ore found has been announced, and even had the ore been assayed the result would have been of little value, as the high-grade found at the Dolly Varden is decidedly spotty. About 20 tons of it is being shipped each month to Tacoma, and brings average return of about 1000 oz. per ton, but the assays of individual pieces of this class of ore will give anything from 100 to 5000 oz. The main thing is the finding of this class of ore in depth, as many were of the opinion that it was entirely a near-surface product. Some high-grade gold ore has been discovered up the George river, which runs into the Portland Canal 17 miles below Stewart. Some of the big paper interests have been examining the Ecstall iron-pyrite property, with a view to utilizing the mineral for the manufacture of sulphuric acid. The Granby company had this property under option for some time, and explored it thoroughly with a diamond-drill. H. S. Munro, manager for the Granby, stated recently that the property contains an immense body of iron pyrite, and undoubtedly some day would be worked for that mineral, but that the copper content was appreciably less than that of the Hidden Creek ore.

Stewart.—The Algunican Development Co. has decided to postpone further development of the George group, situated on the south side of Bear river, Portland Canal mining division, until next season. Considerable progress has been made in opening up the property of the Indian Mines Ltd., situated on the west side of Cascade creek, between the Salmon River glacier and Cascade creek. The claims are at an elevation of 2400 ft. and fourteen miles from tidewater. Development consists of three open-cuts on the croppings and two tunnels. The former expose a vein from 12 to 20 ft. wide, which can be followed on the surface for about 2000 feet.

Alice Arm.—For some weeks there has been a force of about 200 men employed at the Dolly Varden mine. The railway from the mine to the Alice Arm townsite will have to be closed down during the winter. It is understood that some 65 men will be kept on the payroll for development in the mine during the closed season.

Slocan.—The lost vein of the Evening Star mine is reported to have been found from the old tunnel, and there are indications that the old property will be in the shipping class again before long.

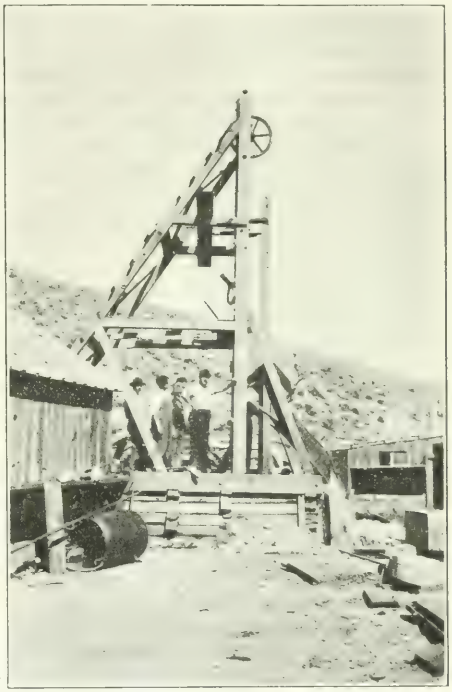
Grand Forks.—A. M. Johnson, who is interested in the Molly Gibson mine at Paulson, states that there are good prospects of the property being a regular shipper, seven feet of high-class ore having been uncovered in the old shaft. The intention is to sink to the tunnel, which has been driven into the mountain a distance of 200 feet.

Marysville.—The Canadian Consolidated Mining & Smelting Co. is about to commence the construction of a concentrating mill on the old site of the Marysville smelter. Preliminary work is in hand.

MANITOBA

OREBODY OF THE FLIN FLON ESTIMATED TO CONTAIN 24,000,000 TONS.

Flin Flon.—Excellent progress is being made in testing the Flin Flon copper property in north-western Manitoba, which is under option to Col. W. B. Thompson of



HEAD-FRAME OF THE MANDALAY MINE, JUNGO, NEVADA

New York and associates. The originally planned expenditure of $200,000 for exploration will be considerably exceeded, as operations now in progress will call for an outlay of about $350,000 as transportation difficulties render working costs very high. It has been ascertained that the orebody formerly estimated to contain 20,000,000 tons will probably run to about 24,000,000 tons. An examination was recently made by Henry Krumm and Andrew J. McNab, chief engineers for Col. Thompson and associates. No. 1 shaft was down 200 ft., the ore was cross-cut disclosing 300 ft. of ore and No. 2 shaft had reached the same depth exposing 185 ft. of ore. From No. 1 shaft drifting was extended 500 ft. south. It was planned to sink each shaft an additional 100 ft. and undertake other development to prove the orebody to a

depth of 300 ft. The option expires March 31, but the Thompson interests must announce their decision by January 1 to the Manitoba government, to allow the latter time to consider the building of the Pas railroad.

ONTARIO

PRESENT WAGE-SCALE WILL NOT BE CHANGED.

COBALT.—The wage-scale at the mines in the Cobalt district is the subject of discussion among the Workmen's Councils. With silver below 80c. per ounce, a flat wage has been paid, with a bonus of 25c. daily for each ten points which silver may advance above that price. Early in the year, on $1.37 silver, the bonus amounted to $1.50 daily. In May, last, the companies announced their intention to pay a bonus based on silver at $1.20, regardless of the lower price. This has meant a daily bonus of $1.50, although silver has declined to under 90c., which entitles the workers to a bonus of 25c. only. This bonus of $1.50 was assured until November 1, and with that date approaching, the workers are endeavoring to obtain from the operators the assurance that this rate will be continued.

Official advice from the Mining Corporation of Canada shows that this company will produce as much silver during 1920 as in the previous year. The achievement is remarkable because the output promises to exceed the amount of silver estimated to be in the reserves at the beginning of the year. The company is opening up the Buffalo mine, which was purchased early in the year, but has not yet commenced to draw ore from this source. It is also unofficially reported that negotiations have been opened with a view to purchasing the Hudson Bay mines, or at least that part of the property lying west of the Townsite mine.

Bullion shipments during the third week of October from the Nipissing amounted to 152 bars containing 200,411 oz. of silver, while in the corresponding period the Mining Corporation sent out 98 bars containing 99,950 oz. This is about 50% above the average.

On October 16 high-grade ore was found at a depth of 100 ft. in the Ruby Silver mines. Including the narrow high-grade streak and the silver-impregnated wall-rock, the silver-bearing material has a width of three feet. Business men of Cobalt have a lease on the property.

The Anvil Lake Silver mines, in the Maple Mountain section of the Elk Lake district, is being re-opened. Meantime, British interests, represented by J. B. Tyrell, are negotiating for the control of the White Reserve mine which lies within a mile of Anvil Lake.

Dr. W. G. Miller, Provincial Geologist for Ontario, and Thomas W. Gibson, Deputy Minister of Mines, are making an official tour of inspection through the mining districts of Northern Ontario.

The Casey-Cobalt, which has produced about 2,500,000 oz. of silver, has gone into voluntary liquidation.

PORCUPINE.—The diamond-drilling on the Porcupine-Mercedes south of Night Hawk lake has been completed comprising about 1200 ft. which has disclosed a wide zone of mineralization. Further diamond-drilling is being considered. A two-ton shipment of ore from the Clifton-Porcupine when milled gave a return of $66 per ton.

KIRKLAND LAKE.—In the Bidgood a drift on the 300-ft. level has cut what is believed to be the vein on which the shaft was sunk at a distance from the shaft of 86 ft. The drift is being continued to tap a vein, which showed up on the surface. A new mineralized body has been encountered east of the shaft.

BOSTON CREEK.—Work has been resumed at the Mondeau which was closed down recently on account of unsatisfactory labor conditions. The Kennedy-Boston is planning to resume underground operations shortly. The force is at present engaged in surface work.

LIGHTNING RIVER.—Active mining operations will be carried on throughout the winter by the Lightning River Mining Co. A force of men has been sent in with a full supply of provisions and material.

BOURKE'S STATION.—The four Wickstead-Oleson claims at Lion Lake have been taken over on option by a syndicate representing Toronto and American capital.

MATACHEWAN.—The Matachewan Gold Mines has completed an extensive diamond-drilling compaign comprising 15,000 ft. of drilling, the results of which are stated to be satisfactory. The greatest depth reached was 600 ft. In addition two shafts have been put down by hand-steel from the first of which 1000 ft. of lateral work has been accomplished on the 200-ft. level. Further development has been deferred until a supply of electric power can be obtained from Indian Chutes on the Montreal river.

TORONTO.—The Imperial Oil Co. of this city has received confirmation of the report that oil had been found on its claims at Fort Norman on the Mackenzie river near the Arctic circle. The first statement was to the effect that the flow of oil was from 1000 to 1500 barrels per day, but a message from the company's geological party, which has returned to Edmonton, while corroborating the news of the strike gives no details as to the flow.

Fort Norman occupies a commanding position on the east bank of the Mackenzie river in the southern angle formed by the entrance of the Great Bear river. It is situated 65° north and 126° west. For long it has been a point of interest on account of the immense beds of lignite which have been burning for the last 130 years, the fires being first noted by Alexander Mackenzie in 1789.

Fort Norman is 900 miles from the nearest calling-point of a river boat, and 1200 miles from the nearest railroad. The only means of access at the present time is down the northern rivers, and these will float boats of only four or five feet draught, and several rapids necessitate the unloading and reloading of cargoes. This precludes bringing oil up the river in quantity until adequate transportation conditions are provided. Added to these disadvantages, the severe cold reduces the period of navigation to three or four months in the year.

The Imperial Oil Co. has staked nine miles along one side of the river and eight miles along the other. This includes the islands in the river. The oil is of excellent quality, running about 40° Baumé.

COPPER PRODUCTION

	September	1920 9 months	1919 12 months
Ahmeek	1,618,300	14,975,138	17,023,111
Allouez	.....	2,499,239	3,749,984
Anaconda	11,100,000	127,850,000	148,872,000
Arizona	3,000,000	36,500,000	32,900,000
Calumet & Hecla	4,169,788	44,049,625	53,859,146
Centennial	.....	561,284	765,196
Calumet & Arizona	3,038,000	31,846,000	46,450,000
Chino	5,161,894	35,734,999	42,325,449
Chile	9,496,000	81,406,000	77,953,084
East Butte	1,634,260	13,647,760	20,382,560
Granby	2,239,174	19,676,932	28,213,552
Greene-Cananea	3,500,000	32,650,000	41,300,000
Inspiration	6,500,000	61,900,000	78,500,000
Isle Royale	727,864	8,175,017	13,007,647
Kennecott	8,878,000	84,755,660	81,914,520
Miami	4,600,000	41,711,500	53,520,091
New Cornelia	3,314,000	32,040,000	42,049,000
North Butte	1,434,159	12,276,060	14,351,067
Nevada Con.	4,650,000	38,821,938	43,971,899
Osceola	643,200	6,401,220	10,825,841
Phelps Dodge	7,998,000	71,450,500	109,155,944
Ray	4,502,000	38,616,073	47,471,322
Shattuck-Arizona	166,513	2,161,313	2,113,922
Superior	46,893	281,393	555,660
United Verde Ex.	3,327,644	32,388,644	28,985,588
Utah	8,420,000	81,757,999	110,591,608
White Pine	82,169	1,743,387	1,979,268
Total	100,247,858	955,877,681	1,152,787,459

CALIFORNIA

Butte County.—Power restrictions which compelled the Feather River dredge No. 3 of the Natomas Co. to close down, have been lifted and orders have been received in Oroville that the big gold boat shall begin operations again. The removal of the power restrictions on gold dredging followed the recent rains.

Nevada County.—The Idaho-Maryland 15-stamp mill is nearly ready but the lower workings of the mine are still filled with water. The hoist for the winze at the Alcalde mine has arrived and will be put in place immediately.

Plumas County.—Work is being pushed on the property of of the Reinmuller Copper Mining Co. in the Lights Canyon district. The company holds about 50 claims by locations, bond, and option joining the Engels mine on the north. A tunnel is being driven to cut the ore about 275 ft. below the surface. John Reinmuller is president. John F. Cowan is one of the directors. The main working and drainage tunnel at the Walker mine has been driven over 4800 ft. gaining a depth of 1000 ft. on the dip of the orebody. A raise from this tunnel is being completed to No. 4 level, an approximate distance of 450 ft. The raise is said to have exposed rich ore. It is understood that the capacity of the flotation mill will be materially enlarged early in the coming year.

Sierra County.—The Kate Hardy mine is showing some good prospects. The drift from the 100-ft. level has opened up a pay-shoot with ore that will run very high. Decision has been reached to begin work this fall on a 300-ft. tunnel to tap the channel in the Bella Union-Poor Boy mine. It is planned to continue the work all winter. The property lies on what is known as the Port Wine ridge and has been extensively prospected by drilling-machines during the past summer. L. A. Thatcher, of San Francisco, who has purchased the machinery at the Gold Point mine, is shipping the machinery to his holdings in other parts of the State.

Yuba County.—The lifting of the power-restrictions in effect since early summer, has permitted the resumption of gold-dredge operations on the Yuba river. Two or three of the eight boats operated by the Yuba Consolidated Goldfields Co. were shut-down, but these boats have been again placed in commission. The other boats, which were working but part time each day, are now operating continuously.

IDAHO

Burke.—The Imperial Mining Co. will make a 700-ft. raise from its lower tunnel to the winze sunk from the upper workings. It will be started 3000 ft. from the portal of the lower tunnel. Homer Brown, secretary, says arrangements are being made to secure a small sawmill with which to cut the lagging and stulls for the raise. About 85,000 ft. of timber will be required. Several streaks of quartz have been found in the face of the lower tunnel of the Washington Mining Co.'s property, according to reports. Assays give a return of several ounces of silver per ton. In the upper tunnel of the property a stringer of galena ore more than a foot in width has been found.

Wallace.—The Callahan Zinc-Lead Co. shipped 4,230,000 lb. of zinc concentrate in September. In the same period it shipped 2,180,000 lb. of lead concentrate and 21,800 oz. of silver. At the time of the dividend disbursement, September 30 last, it was announced that development was proceeding on the Nipsic and Interstate veins. The Hope Mining & Milling Co. has obtained title from the State of Idaho to its property on the east side of Pend Oreille lake, 1½ miles from Hope, where the State recently sold a total of 3240 acres. This property was formerly known as the Morning Star group, for a long time supposed to be on Government land and was so located. Directors of the company say that, now that title has been secured, work will be resumed in a short time and a 1500-ft. tunnel driven to cross-cut six or seven veins. The new tunnel will be 600 ft. below the present main tunnel. In the upper tunnel 14 in. of high-grade ore was uncovered. A 45-ton car of silver-lead concentrate was shipped recently by the Big Creek Mining Co. in the Coeur d'Alene. The new mill of the company is running full time and treating 75 tons per day. Important in the plans of development of the company is the raise which will soon be commenced in the lower tunnel to reach the next tunnel above which is 550 ft. higher. From this raise levels will be opened for the extraction of ore for the mill. The Columbia section of the American Institute of Mining and Metallurgical Engineers will hold its annual meeting in Kellogg and Wallace, October 29 and 30, according to announcement issued by L. K. Armstrong of Spokane, chairman of the section. One session will be held at Kellogg and

the Bunker Hill works and smelter will be inspected. Another session will take place at Wallace and various mines and mills adjacent to Wallace will be visited.

NEW MEXICO

Lordsburg.—It is reported that the diamond-drill work in progress at the 85 mine, recently purchased by the Calumet & Arizona Mining Co., is resulting favorably.

Mount Franklin.—Alfred Roos and associates are reported to have purchased what is said to be, from surface indications, one of the largest fluorspar deposits in the country, situated in the extreme northern part of the Franklin Mountain range, just north of the line between New Mexico and Texas, and about 25 miles north of El Paso. The two vein-systems are said to be more than a mile long, and the quality is believed to be excellent, containing no other impurity than silica.

WASHINGTON

Spokane.—The Bead Lake Mining Co., seven miles from Newport, in Pend Oreille county, owned largely by Spokane capital, is building a 100-ton concentrator to be completed by the first of the year. Two separate properties are owned by the company. One is copper and the other silver-lead. Both are developed to the stage where they are capable of steady production. The galena lode has been developed on four levels to a depth of 500 ft., showing a vein from 8 to 14 ft. wide, most of the vein being a high-grade milling-ore with much first-class ore. Copper holdings of the company adjoin the silver-lead property and have been developed to a depth of 750 ft. The vein is two to four feet wide, the ore being chalcopyrite. From the bottom of the shaft the vein has been followed 700 ft., the ore being low-grade most of the distance.

MEXICO

Coahuila.—Approximately 6000 coal miners in the State of Coahuila are reported to be out on strike, and several men have been killed in encounters between workers and soldiers protecting the coal mines at Agujita.

Sonora.—The construction of a railroad from Agua Prieta on the international border over the Sierra Madre mountains to Casas Grandes on the east side of the mountain range, is reported to have been authorized by the Mexican government. The route of the road will be over the Pulpito Pass on the Sierra Madre mountains and north-west to Agua Prieta. An extension will connect, it is said, with the Southern Pacific of Mexico, south of Nogales. The total length of the proposed road will be nearly 200 miles. After a ten day trip in Sonora, T. B. Johnson and J. E. Meyers of El Paso, are reported to have discovered and denounced the Klondyke placer. Fifty pertenencias or 125 acres covering about two and a half miles up and down the gulch, including dam-site for storage of water for hydraulic purposes, have been denounced. The property is located about 90 miles south of Nacozari, and about five miles from the Monte Cristo mine, owned by a syndicate of prominent business men. The Monte Cristo mine is reported to be in operation and extracting high-grade silver ore from the mines as well as working over the old dumps. This mine has a record of having yielded approximately $1,000,000, and 10 carloads of concentrate shipped to the El Paso smelter yielded $150,000.

Mose Sevey, an American citizen, superintendent of the Cananea-Duluth mine of the Cananea Consolidated Copper Co., was fatally injured on October 20, due to a gunshot wound inflicted by a Mexican employee.

Hidalgo.—The Compania de Real del Monte y Pachuca, Mexican subsidiary of the U. S. Smelting & Refining Co., and situated at Pachuca, has recently purchased the Arevalo properties about six miles from Pachuca for $1,250,000.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

F. W. Bradley is at Kellogg.

R. A. F. Penrose, Jr., passed through San Francisco last week.

W. C. Minsch is with the Minas del Tajo, at Rosario, Mexico.

Philip Wiseman is in New York, on his way home to Los Angeles.

H. R. Bischoff is with the Crown Reserve Mining Co., at Cobalt, Ontario.

Gilmour E. Brown is visiting the Chino Copper Co., at Hurley, New Mexico.

F. F. Friant, recently at Dos Cabezas, Arizona, is now at Port Orford, Oregon.

M. G. F. Sohnlein is in Holland. He expects to return to Chile early next year.

H. C. Goodrich, chief engineer for the Utah Copper Co., was in San Francisco recently.

P. K. Lucke has gone to Europe, from Mexico, and will return at the end of December.

Harvey S. Mudd left New York on October 22, on his return from London to Los Angeles.

Robert D. Longyear, of the E. J. Longyear Co., of Minneapolis, was in San Francisco this week.

David White, Chief Geologist, U. S. Geological Survey, is visiting the branch office in San Francisco.

S. F. Hunt, lately superintendent for the Tybo Lead Co., at Lucin, Utah, has moved to Tecoma, Nevada.

Charles P. Richardson, manager of the Slim Jim mine, at Sawyer's Bar, California, is in San Francisco.

Thomas M. Bains, Jr., is now at the Missouri School of Mines, at Rolla, having left Mariposa, California.

Fred B. Ely is making a geologic survey for oil and gas in Coahuila, Nuevo Leon, and Tamaulipas, in Mexico.

John D. Hoffmann is consulting engineer to the Mawchi Mines Ltd. and Yuanmi Gold Mines Ltd., with headquarters in London.

George E. Collins, of Denver, has been in New York. He is chairman of the Flotation Conference to be held at Denver as a part of the meeting of the American Mining Congress.

Garret Mott, president of the Castle Dome Mining Co., and chairman of the executive committee of the Superior & Boston Copper Co., together with **John Kasser,** is at Globe, Arizona.

Walter Harvey Weed announces that he has severed all connection with Harris & Co., of 25 Broad street, New York. His addresses are 29 Broadway, New York, and Tuckahoe, New York.

J. G. Flynn has resigned his position with the Miami Copper Mining Co., at Miami, Arizona, to accept a position as mine superintendent with the El Oro Mining & Railroad Co., at El Oro, Mexico.

G. F. Loughlin, Chief of the Division of Mineral Resources, U. S. Geological Survey, and **Charles G. Yale,** in charge of the San Francisco office of the Survey, will be at Salt Lake City early in November.

Gerald R. Simpson, recently superintendent for the Standard Minerals Co., at Kingman, Arizona, has opened an office in the Haas building, at Los Angeles, as manufacturer of his invention, a pneumatic flotation-cell.

F. H. Curry, formerly with the Inspiration Consolidated Copper Co., sailed on October 22 from New York on his way to the Belgian Congo, where he is to be mill superintendent for the Union Minière du Haut Katanga.

THE METAL MARKET

METAL PRICES

San Francisco, October 26

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	17.50
Lead, pig, cents per pound	7.50—8.50
Platinum, pure, per ounce	$95
Platinum, 10% iridium, per ounce	$135
Quicksilver, per flask of 75 lb.	$65
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

October 25.—Copper is inactive and nominal. Lead is quiet and weaker. Zinc is dull and easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 45.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date		New York cents	London pence
Oct.	19	76.25	51.50
"	20	78.12	51.87
"	21	81.37	53.25
"	22	80.50	52.62
"	23	80.00	52.12
"	24 Sunday		
"	25	80.87	52.50

Average week ending		Cents	Pence
Sept.	13	93.96	59.15
"	20	94.31	60.08
"	27	93.52	59.66
Oct.	4	91.65	58.98
"	11	86.77	55.66
"	18	83.10	54.05
"	25	79.52	52.31

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	93.66
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	....
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		
Oct.	19	16.00
"	20	16.00
"	21	15.75
"	22	15.75
"	23	15.50
"	24 Sunday	
"	25	15.50

Average week ending		
Sept.	13	18.75
"	20	18.75
"	27	18.70
Oct.	4	18.50
"	11	17.85
"	18	17.15
"	25	15.75

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	18.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	18.75
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	....
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		
Oct.	19	7.25
"	20	7.25
"	21	7.00
"	22	7.00
"	23	7.00
"	24 Sunday	
"	25	7.00

Average week ending		
Sept.	13	8.29
"	20	8.06
"	27	7.85
Oct.	4	7.54
"	11	7.50
"	18	7.50
"	25	7.08

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.63	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	8.08
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	....
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	44.43
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	....
May	100.11	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		
Oct.	19	7.50
"	20	7.50
"	21	7.50
"	22	7.50
"	23	7.50
"	24 Sunday	
"	25	7.50

Average week ending		
Sept.	13	7.83
"	20	7.83
"	27	7.73
Oct.	4	7.66
"	11	7.55
"	18	7.41
"	25	7.50

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	7.84
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	....
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		
Sept.	28	75.00
Oct.	5	75.00
"	11	75.00
"	19	70.00
"	26	65.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	75.00
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

JAPANESE COPPER SPECULATION

"Exportation of American copper to Japan has ceased," says 'The Boston News Bureau'. "Since January 1, 1920, there has been shipped to the Orient 80,000,000 lb. of copper, of which a large proportion, it is believed among domestic producers, has been re-sold and shipped to Europe in competition with American agencies abroad.

"During the three years ended June 30 last, there had been exported to Japan 146,349,518 lb. of copper, of which 139,980,773 went out in the last period, indicating the extraordinary movement which was getting under way during the first half of 1920.

"The movement had apparently been completed last June, with shipments in that month of 4,417,980 lb. July saw the exportation of but 940 lb. to that country, while in August not a single pound was sent over.

"That the movement was almost entirely speculative producers admit, while further confirmation appears in the actual shipments, which have been as follows (pounds):

Year to June 30, 1920	139,980,773
1919	6,287,620
1918	81 125
Three years	146,349,518
July 1920	940
August 1920	none

"A decade ago there was a somewhat similar movement of copper to the Far East, although at that time shipments were sent to China, where, it was said at the time, heavy minting was to be undertaken. It was later developed, however, that the buying of many millions of pounds of copper for Chinese account covered an extraordinary speculative operation."

SILVER

Samuel Montagu & Co. says: "It has been rumored that there have been sales of bar silver from India to China. The last named country is now in the remarkable position of sustaining, like a modern Atlas, the silver market of the world—less the 45,000,000 oz. per year absorbable under the Pittman Act. It is important to notice that, if the report be true, the markets have had two sources of supply besides production, namely, demonetized silver from the Continent, and an overflow from India, which might almost be described as demonetization in that quarter. There is no doubt that it was the probability of the export of silver rupees becoming feasible as a result of the position of exchange that impelled the Bazaar price downward to about 106 rupees the 100 tolas—that is to say, 2% rupees per 100 tolas below the Indian intrinsic value of full-weight rupees.

"We remarked long since that the extremely large remittances of silver to China the last year or so, were not only owing to the replacement of the silver shipments made during the War from that quarter to India for coinage, but also to the ill odor into which paper money had fallen as a consequence of the Russian debacle. This distrust of notes still continues in the interior of Asia, and it may be taken for granted that China is for a while in a position to import and retain, or to consign into the interior, more silver than in the past—perhaps even 50,000,000 or 60,000,000 oz. per annum. This accounts for the ease with which China has continued to take the metal. It is stated that the imports of silver into China have amounted to nearly 52,000,000 oz. between the beginning of January and the end of August this year."

MONEY AND EXCHANGE

Foreign quotations on October 26 are as follows:

Sterling, dollars:	Cable	3 47¾
	Demand	3 48½
Francs, cents:	Cable	6 40
	Demand	6 41
Lire, cents:	Demand	3 80
Marks, cents		1 49

Eastern Metal Market

New York, October 20.

There is no life in any of the markets and the tendency in most of them is downward.

Copper values have touched new low levels on this movement on free offerings. Sales have been very light.

The tin market continues quiet and featureless. Prices have again declined.

The lead market is the most stable of all, but demand is very light.

The buying of zinc is of small proportions with the tendency easy.

Antimony is lower.

IRON AND STEEL

The movement toward lower prices for pig-iron and the products of independent steel mills is more rapid and there are more shut-downs and curtailments of production, says 'The Iron Age'. Signs now point to a decline in both pig-iron and steel-ingot output in October, though an increase was indicated as the month came in.

The most significant development of the week is a break in coke, which apparently marks the end of the extreme prices that have ruled for months. With a decline of $2 per ton in the week and both blast-furnace and foundry operations on a diminishing scale, considerable contract coke is being released meanwhile, buyers once more have something to say in that market. The efforts of the Ford Motor Co. for a revision of its contracts on cold-finished steel bars have met with fair success.

The belief that activity will succeed the present hesitation early in the new year is prompting the policy in some cases of adjusting operations for the time being to the limited demand, without pressing for new business. Meanwhile concessions are largely confined to the smaller mills.

Two large consumers of tin plate on the Pacific Coast, one at Seattle and the other at Vancouver, have been covered for their first half of 1921 needs by the American Sheet & Tin Plate Co. at that company's maintained $7 basis.

COPPER

The copper market has continued to decline and new low levels have been reached on this movement. There is no question but that the outside producer, so called, and the dealers have cut values decidedly. In some cases these reductions are being met and sales have been made at the lower values by some large producers. But the amount of buying is light and not a fair test of the market. Nevertheless there has been some business. The market for both Lake and electrolytic copper may be quoted at 16 to 16.50c., New York, for early delivery. Sales have been made at 16.25 and 16.37½c. There has been some business done in the last week for export at prices considerably above the foregoing values. Consumption continues good and production is decreasing. Sentiment is not pessimistic in all quarters and the worst is believed to have passed.

TIN

Quietness continues to characterize this market and there are no features. It is reported that a moderate business was done during the last week by dealers and consumers on future-shipment metal, but as a whole the market is devoid of life or animation. It is partly disheartened. There are reports also of financial difficulties in the Far East and in Holland which have resulted in failures on a large scale in some places and may end in others. The effect of the British coal strike is being watched. As a result there have been bear raids on the London market which have depressed prices some £20 per ton. This has had its sympathetic effect here and values have declined. Spot Straits tin was quoted yesterday at 38.25c., New York, though it was 37.75c. on Monday. In London spot Straits fell to £240 10s. on Monday, but recovered to £243 15s. yesterday. There was a recovery also yesterday of £2 to £3 in spot and future standard tin to £241 15s. and £247 10s., respectively. Arrivals thus far this month have been 1565 tons with 5075 tons afloat.

LEAD

This market has been the least affected of all recently. Demand is exceedingly light. The only feature was another reduction in the price of the leading interest on Monday of ½c. per pound to 7c., St. Louis, and 7.25c., New York, which was a readjustment to the outside market. We quote the market 7c., St. Louis, or 7.25c., New York, with imported metal at about the same as the New York market or 7.25c., seaboard, duty paid. The domestic market is very close to being lower than, or as low as, it is possible to import lead.

ZINC

This market is quiet, fairly steady, and devoid of features. Prices have eased slightly and prime Western for early delivery is quoted at 7.25c., St. Louis, with the imported metal, re-shipped from England, available at 7.50c., New York, or seaboard. The effect of the British strike may be to reduce the quantity from this source. Producers are cutting production and declining to sell except where necessary, confident of the future market's strength.

ANTIMONY

The market is quiet and easier with wholesale lots for early delivery quoted at 6.50 to 6.75c., New York, duty paid.

ALUMINUM

There has been a revision of prices by the leading producers. Virgin metal, 98 to 99%, is quoted now at 32.90c. f.o.b. producer's plant. The outside market is quoted at 28.50 to 29.50c., New York.

ORES

Tungsten: Off-grade Chinese ore has sold in moderate sized lots at $4.50 per unit. Other grades are in poor demand and nominally unchanged. Bolivian ore is quoted at $5 to $5.50 and 60% scheelite at $6 per unit. Ferro-tungsten is unchanged.

Molybdenum: The market continues quiet with prices nominal at 75c. per pound of MoS_2 in regular concentrates.

Manganese: Demand is light. One consumer has offered 42c. per unit for several thousand tons but was unsuccessful. The last sale was at 53c.

Manganese-Iron Alloys: Re-sale ferro-manganese has sold in small lots on a basis of $155, seaboard. The regular quotation is $170, seaboard. Demand is very light. The spiegeleisen market is inactive but strong at $80 to $82.50, furnace, for the low and high-grade, respectively.

AMERICAN METAL TO SELL CERRO DE PASCO OUTPUT

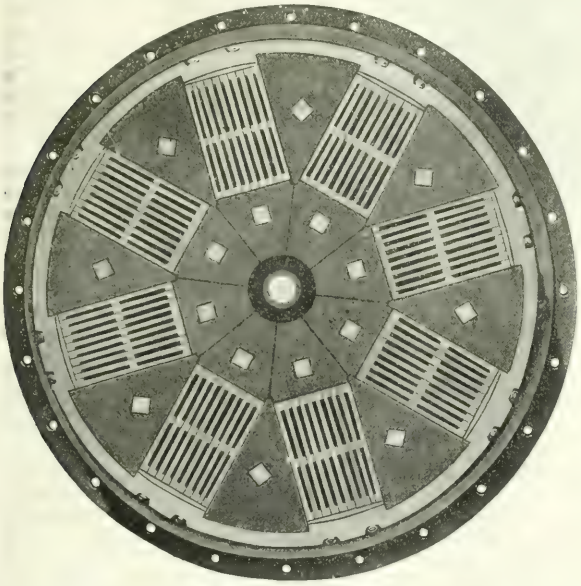
The Cerro de Pasco Copper Co., at the expiration of its present contract with the American Smelting & Refining Co. the last of this year, will switch the refining and sale of its product to the American Metal Co. The production under capacity operation will run above 100,000,000 lb. of copper per annum. This constitutes the largest and most important change among the copper-selling agencies in the past few years, one of the most recent having been the withdrawal of the Copper Range Co. from the United Metals Selling Co. group and the subsequent establishment of its own sales department.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

ALLIS-CHALMERS BALL-GRANULATORS

The ball-granulator, as developed by the Allis-Chalmers Manufacturing Co., was originally designed to crush 2 or 3-in. ore down to a fineness of 10 to 80-mesh. Actual experience has shown it to be equally efficient as a fine grinder when reducing 8 to 20-mesh feed to anywhere from 100 to 200-mesh. The company claims that after careful study of



Variable-Discharge Diaphragm

the principles of ball-mill grinding and the troubles encountered with the earlier designs constructed for this work, it has succeeded in producing a mill that eliminates the difficulties heretofore encountered, and added several special features, which are hereinafter described more fully.

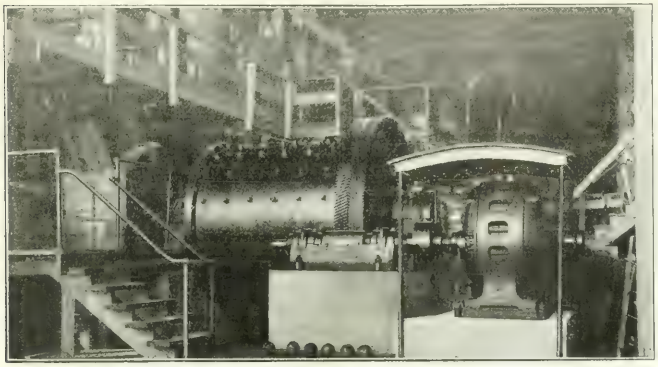
Recent experimental work on the crushing of coarse material in ball-mills shows that the most efficient crushing effect is obtained by direct impact of the falling balls. While it is true that a large amount of grinding is done by attrition, or by the rubbing of the balls upon each other, it is believed the crushing of coarse material is effected mainly by impact and that attrition acts principally on fine material. For practical purposes, we may assume that the pulp in a ball or tube-mill remains level and that this level is fixed by the height of discharge and is not affected laterally by centrifugal force at the speeds obtaining in ball-mill practice. In the open trunnion-discharge type of mill, half full of pulp, a great deal of useful energy is wasted by the balls falling through a thick pulp, thereby reducing the force of their impact. On the other hand, in a peripheral-discharge type of mill, when crushing coarse material the ore receives the force of the impact of the balls and all this energy is utilized in crushing. When reducing 3-in. feed, the large feed acts as a cushion for the balls, but with fine feed, say one-half inch or less, the pulp does not offer sufficient resistance to give a cushioning effect, with the result that the balls strike on the shell-lining, causing excessive wear of both lining and balls. By maintaining the pulp-level at a point sufficiently high to interpose a bed of pulp to partly cushion the impact of the balls, the maximum crushing effect with the minimum wear of steel is obtained.

In no other ball-mill except the Allis-Chalmers ball-granulator is there any means for controlling the pulp-level except by regulating the feed of ore and water. It is impossible to maintain such regulation at a fixed rate and ratio, hence the pulp-level cannot be regulated accurately by this means. The idea has been to design a mill in which the pulp-level can be positively controlled to suit the varying conditions arising in practice and to maintain a high crushing efficiency and a low ball and lining-consumption. The pulp-level in the Allis-Chalmers ball-granulator may be varied from the periphery to a point approximately half way between the trunnion and the periphery. This variation is obtained by the patented G-H diaphragm. This divice consists of a diaphragm with radial ribs cast on the back and with round openings between the ribs opposite the screen or grating. On the inner face of this diaphragm is mounted a grating or screen made up of high-varbon tool-steel bars, disposed radially and tapered to obviate blinding. The spaces beween the grates are covered with liners held in place by through-bolts; with the apertures in the diaphragm left open the mill will discharge to within 3 or 4 in. of the periphery, but by closing the outer ring of openings with wooden plugs the discharge is raised accordingly and by this means the pulp-level in the mill can be accurately regulated to suit the material crushed. Thus, without any change whatevere in construction the mill can be adtpetd to almost any ration of crushing and also for varying tonnages. The radial ribs act as elevators lifting the pulp and discharging it at the trunnion level. Access to the wooden plugs may be had through the hand-holes on the outside of the mill. The grates can be replaced without removing the mill from the foundation or dismantling it.

The capacity of the Allis-Chalmers ball-granulator with variable-discharge diaphragm is from 30 to 40% greater than the trunnion-discharge type mill with an increased power-consumption of about 20% when discharging at the periphery. As the height of discharge is raised the capacity and power decrease proportionately until the maximum height of discharge is reached (a point about half way between the trunnion and periphery), when the increase in capacity is 15 to 20% and the power 10% over the open trunnion discharge.

The ball-granulators are designed for using hard iron or

steel balls as a crushing medium. A mill loaded with balls has a capacity about 2½ times greater than when loaded with pebbles. Balls increase the capacity in direct proportion to the increase in weight. The weight of balls and height of fall determine the maximum size of feed that can be crushed. This explains why ball-mills loaded with 3 and 4-in. balls take a coarser feed than tube-mills loaded wih pebbles of the same size. The capacity and power increase directly with the ball load until it reaches a level slightly below the axis. Further loading does not increase the capacity, whereas the power increases proportionately. Although in tube-mill practice the pebble load is carried up to or in some cases above the axis of the mill, it is not necessary or advisable to carry the ball load up to the axis in an Allis-Chalmers granulator, in fact, experience would show that on some ores the greater efficiency is obtained by carrying the ball load as much as 8 or 10 in. below the axis.



Allis-Chalmers Ball-Granulator Crushing Quartz Ore

BOILING-POINTS OF WATER UNDER REDUCED PRESSURES

The following table is found useful by the engineers of the Oliver Continuous Filter Co. and we give it for the benefit of those engaged in similar lines of industry.

Vacuum		Boiling-point		Altitude	
Inches	Millimetres	Deg. F.	Deg. C.	Feet	Metres
30	761	32	0	0	0
29	736	79	26.1	800	244
28	711	101	38.3	1,800	549
27	685	115	46.1	2,700	824
26	660	125	51.6	3,700	1,128
25	635	133	56.1	4,700	1,434
24	609	141	60.5	5,700	1,738
23	584	147	63.9	6,700	2,043
22	558	150	65.5	7,700	2,348
21	533	155	68.3	8,700	2,653
20	508	160	71.1	9,600	2,928
19	483	165	73.9	10,500	3,202
18	457	169	76.1	11,400	3,477
17	432	172	77.7	12,300	3,751
16	406	176	80.0	13,200	4,026
15	381	179	81.6	14,100	4,300
14	355	182	83.3	15,000	4,575
13	305	186	85.5	15,900	4,849
10	254	191	88.3	16,800	5,124
8	203	196	91.1		
6	152	201	93.9		
4	101	205	96.1		
2	50	208	98.0		
0	0	212	100.0		

The Holt Manufacturing Co., Inc., of Peoria, Ill., is issuing a small bulletin with illustrations of its 'caterpillar' tractors pulling road-making machinery and engaged in the actual work of road-making. With the illustrations is given a detailed statement of the cost of operation compared with animal haulage on the same job.

COMMERCIAL PARAGRAPHS

The Mine & Smelter Supply Co. announces the appointment of Harry J. Gundlach as sales manager of its Denver branch.

The Henry E. Wood Ore Testing Co. has removed its assay office and chemical laboratory to 1750 Arapahoe street, Denver, Colorado. Hereafter this branch of the business will be known as The Henry E. Wood Assaying Co.

The Cement-Gun Co., Inc., of Allentown, Pa., has recently issued a small booklet showing the results of tests made on reinforced gunite floor-slabs together with working and safe-load tables, established by the tests, for this type of construction. The data therefore are both new and useful.

Dwight P. Robinson & Co., Inc., engineers and constructors, consolidated with Westinghouse, Church, Kerr & Co., has appointed Carl C. Thomas as its Western representative, with offices in the Electric Equipment building, 1240 South Hope street, Los Angeles.

The Walworth Manufacturing Co., Boston, Mass., has recently issued Export Catalogue No. 35 for pipe-fittings and similar material. This catalogue is printed in English, Spanish, French, and Portuguese with conversion tables and index. Everyone with foreign experience realizes the difficulty in translating technical terms and extra attention has been given to making this as correct as possible. The catalogue is intended for use only in those countries using British standard thread.

R. D. Nuttall Co., manufacturers of gears, pinions, and flexible couplings, has equipped new and permanent quarters at 429 Title & Trust building, Philadelphia, Pa., to handle direct, all business other than electric-railway and mine-haulage supplies. This office will be a direct Nuttall office and will be in charge of R. F. Fiske.

The Nordberg Manufacturing Co., at Milwaukee, Wisconsin, has just completed an extension of its main machine shop and bays. The new addition, which is 200 by 180 ft., will facilitate the erection of large engines and hoists, such as the 2000-hp. Diesel oil-engine and several large hoists now on order. One of the latter, known as the Mitsue hoist in Japan, will be the largest hoist ever exported.

Dwight P. Robinson & Co., Inc., (with which Westinghouse, Church, Kerr & Co., Inc., has recently consolidated), engineers and constructors of New York, has established a new branch office in Youngstown, Ohio, in the Home Savings & Loan building, in charge of C. I. Crippen. The company recently moved its Cleveland office from the Leader News building to the Citizens building, and H. P. Clawson, who was for several years a member of the Chicago staff, has been transferred to Cleveland to take charge of this office. The company now maintains branch offices in Pittsburgh, Youngstown, Cleveland, Chicago, Dallas, and Los Angeles, and Sao Paulo, Brazil.

The Westinghouse Electric & Manufacturing Co. is distributing Motor Application Circular No. 7132, entitled 'Electrification of Excavating Shovels', which describes and illustrates the various uses to which electric shovels may be put, such as railway work, coal-mining, and drag-line excavating. The method of electrifying is discussed, together with an outline of the choice of equipment. Advantages of electric shovels are fully considered and results of recent tests are given, that show the cost per cubic yard of material removed by means of these shovels. Tables are produced which show the approximate energy-consumption of electric shovels and drag-line excavators.

T. A. RICKARD, ... Editor

RECOGNITION of the new Mexican government seems assured at an early date, and we are glad of it. We should aim to maintain as friendly relations with our southern neighbor as with our northern. Señor Obregon has given every evidence of a desire to establish an *entente cordiale*.

SILVER production of the world will fall short of the pre-war rate by fully 29,000,000 ounces, according to estimates submitted at the International Financial Congress at Brussels. The production for 1920 is placed at 195,000,000 ounces, as against 223,900,000 ounces in 1913. This ought to strengthen the silver market.

OUR London contemporary, 'The Financial Times', talks about the boom in Mexican shares in a most cheerful way. The favorable turn in political affairs has synchronized with the cutting of a rich orebody in the Esperanza mine at El Oro and generally favorable developments in British-owned mines in other districts, notably Pachuca. Esperanza shares rose within a month from 13 shillings to 50 shillings, so that somebody made some money. The shares of the old Exploration Company have risen considerably, and, in general, there is a sentiment highly favorable to Mexican mining. Several new ventures are said to be on the eve of flotation.

WE sympathize with the Judge whose colloquy with Mr. William E. Colby we quote on another page. He started to make some criticisms on expert testimony in general and found that he had hurt the feelings of several gentlemen whom he knew to be honorable men; so he returned to the subject and disclaimed any personal attack. The colloquy is interesting and that is why we quote it. So is the contribution on the same subject from Mr. F. L. Ransome, who writes as the editor of 'Economic Geology', and as one wholly detached from the delicate situation created by the adaptation of scientific testimony to mining litigation.

AT the forthcoming convention of the American Mining Congress, at Denver, on November 15 and following days, there will be public conferences on a number of timely topics. The use of the flotation process and the terms of licensing will be the subject of one meeting, to which representatives of the Minerals Separation company have accepted an invitation. A report on the Federal Trade Commission's investigation of the Minerals Separation company's methods will be presented. A National Gold Conference is to discuss the gold problem in relation to mining, and Representative McFadden will be present, to explain the advantages of the Bill he has introduced for the levy of an excise tax on the gold used in manufacture. On the same occasion Mr. H. N. Lawrie, statistician for the Mining Congress, will review the legislative campaign for the relief of the gold-mining industry.

NEXT Thursday we celebrate the second Anniversary of the Armistice, yet we are still technically at war with Germany. Four days later the League of Nations assembles at its new headquarters in Geneva, whereas we have not yet made up our minds whether to join or stay out. Meanwhile the League has succeeded in arranging the dispute between Poland and Lithuania, and has intervened successfully between Sweden and Finland, which otherwise might have gone to war over the Aland islands. Furthermore, the moral pressure of the League has caused the Russians and the Poles to cease hostilities. All this is of good augury. When are we going to give a hand in the good work?

FROM a recent official bulletin, issued in the City of Mexico, we note that out of 1261 mercantile establishments in the State of Sonora, four were American company mine-stores, 430 belonged to Mexican, American, German, and other owners, and 827 were Chinese. In capital, ₱755,000 represented mining-company stores, ₱1,080,000 was American and European, ₱978,540 was Mexican, and ₱2,186,935 was Chinese. Of the 827 Chinese stores, 740 had a capital of less than ₱5000 and only 11 had a capital of more than ₱10,000. The increase in Chinese is given: from 850 in 1900, to 4000 in 1910, and 12,500 in 1919. As a class, the bulletin says, they are healthy, honest, and industrious; however, they are addicted to drugs, have low standards, and work as single men, so that they compete on favorable terms with other nationals having families.

LITIGATION over the Minerals Separation patents is making slow progress. The Nevada Consolidated Copper Company and the Magma Copper Company are the two latest defendants. They have answered the

plaintiff's bill of complaint with a general denial of the charges of infringement. The Nevada company in its reply alleges that the Minerals Separation people at various times asserted that their process "could not be adapted to ores such as those of the defendants". It also avers that "things alleged to be patented had been abandoned to the public", and that the Minerals Separation people are not the original inventors of the process, citing the names of patentees of earlier processes. The Magma company follows its general denial by questioning the plaintiff's statement of a readiness to grant licenses; it avers that Minerals Separation insists on restrictive terms and conditions of license. Meanwhile the suit against the Miami Copper Company is dragging along, the Master's hearing on alleged profits not having been finished as yet.

WE take keen pleasure in publishing a contribution from Mr. Sam A. Lewisohn, of Adolph Lewisohn & Sons, a firm identified with large and successful copper enterprises. His subject is the human factor in mine management, concerning which he is able to write convincingly not only by reason of his intimate connection with mining but also on account of a liberal and humane spirit, without which any discussion of the subject would be sterile. Indeed, we shall not progress far in the improvement of industrial relations until men of character and authority show themselves willing to come forward and discuss delicate points frankly and fairly, as Mr. Lewisohn does. We shall be glad if others will continue the discussion.

AS truth is stranger than fiction, so actual mine reports are weirder than any that one could concoct. Among recent examples of the delirious trimmings of geology we quote from a report on the Carmen Creek district, in Idaho. The author, who calls himself a "consulting, mining and metallurgical engineer", says: "The formation consists of Alkonkian Shist, which through the Igneous Magma forming the Dyke as a Bysmalith breaking through the older formation. In its action of rising the meshing and grinding force, produced by the force below, ground the Shist to a Clayey Calcarrious Argillareous mess to the West and North, and to the East and South to a Shistose Shale or Shist. The Magma itself carrying some mineralization with it, which, and being encast through the period of crystalization, the most of the minerals staying below in molten state was carried in the state of vapor aided by the action of water as an Aquallarious Igneous fume through the crevices of the slowly cooling Magma." It is evident that the typist contributed to this appalling result, but not sufficiently to spoil the style of the original. Indeed it is a "clayey calcarrious argillareous mess", and it seems astounding that such a document could be given forth seriously. The author estimates the property to contain 2,920,909 tons, note the needless precision of one that he calls "probable ore in the developed area, blocked out", leaving his client to choose between the three terms, 'probable', 'developed', and 'blocked out'. This supposed ore contains $5.50 in gold and silver, and the cost of mining it "under economical conditions should not exceed 20 cents per ton, leaving a big margin over the cost of metallurgical treatment". But the question arises, what process under the sun could treat successfully such a "clayey, calcarrious argillareous mess"? It sounds a bit sticky.

THE BUREAU OF MINES has announced the program of investigations to be undertaken at the newly created Mississippi Valley experiment station, together with several appointments of members of the staff. Apparently headquarters for the Station will be at St. Louis, where Mr. J. J. Rutledge is to be acting-superintendent, whereas the actual research on ore-dressing and milling, and on the electro-thermic metallurgy of zinc, will be done at Rolla, in conjunction with the Missouri School of Mines. Mr. John Goss will be in charge of milling and Professor Charles H. Fulton, director of the School of Mines, will supervise the work on smelting, in the capacity of consulting metallurgist to the Bureau. The investigation of the best methods of sharpening, tempering, and using drill-steel is to be undertaken in collaboration with the North-Central station of the Bureau, which is at Minneapolis. The question suggests itself, why is the administering to be done in one place and the actual work in another? If Rolla is the most desirable place for the station, should not the offices also be there? We wonder, too, why it is necessary to select for investigation a problem that has already been assigned to another station. This must mean either duplication or dissipation of energy, neither of which is conducive to efficiency. There must be some valid reason for these things that does not appear on the surface. It is to be hoped that the taint of politics has not touched the Bureau.

The Rising Tide of Color

This is the title of a remarkable book by Mr. Lothrop Stoddard. We shall discuss its main thesis apropos of the Japanese question in California, to which we turned in our issue of October 16, and to which Mr. C. A. Grabill contributed in our issue of October 30. The immigration of Japanese into California may be considered as a part of the tide of color that menaces white civilization. According to Mr. Stoddard the white race at a time of weakness, consequent upon the European war and the ensuing disintegration, is menaced by "a definite movement half-conscious and half-instinctive against the white world-supremacy", which has been established by four centuries of domination. Before that, in the fifteenth century, the tide of colored invasion nearly submerged Europe; the Turks captured Constantinople, the Tartars swept over the plains of Russia; the Moors occupied half of Spain; the brown men dominated the shores of the Mediterranean. Thereupon the people of Northern Europe took to the sea and colonized distant lands with their virile stock; the dark invaders were driven back

into Asia and Africa; the white race laid the foundations for a new supremacy, typified by the United States. Groups of white people migrated to the countries of the dark peoples and established outposts, which within the last four hundred years have won dominion over a large part of the world inhabited by the dark peoples. Australia and Africa are entirely subject to white control; nearly all of North America; a small part of South America; and a large part of Asia. Of the dark races, those of Asia are asserting themselves; the Chinese, the Japanese, and the Hindoos have progressed in intelligence, in material wealth, and in population. The pressure of population has set loose the forces of racial rivalry; the Asiatic hordes look hungrily toward foreign areas of colonization and begin to reverse the tide of migration. The movement is unorganized; it is largely instinctive and individual; it is not prompted by official suggestion as yet; it is an ethnic phenomenon that in time may develop into a conscious racial demand for self-determinative freedom from "the white man's burden" and for possession of the productive regions of the earth. Mr. Stoddard makes no effort to excite prejudice against the colored race, but he emphasizes the fact that the white and the colored cannot live side by side without injury to the former; in the ensuing competition the white race becomes sterile, while the dark one breeds rapidly. As he says: "A generation ago relatively few persons realized that low-standard men would drive out high-standard men as inevitably as bad money drives out good, no matter what the results to society and the future of mankind. These are but two instances of that shallow cocksure nineteenth-century optimism, based upon ignorance and destined to be so simply and tragically disillusioned." Mr. Stoddard's remedy, in brief, is to leave the whole of Asia to the Asiatics, while barring them from America, Canada, and Australia. A reviewer in 'The Spectator' demurs to this proposal, fearing that the result will be to turn Asia into "a seething pot of anarchy", but the question may well be asked, if the races of Asia are to continue to multiply, whither is the surplus to go if not to the Asiatic hinterland? In conclusion, Mr. Stoddard extends the problem of racial incompatability to the lesser breeds of the white race; he says: "Even within the white world, migrations of lower human types like those which have worked such havoc in the United States must be rigorously curtailed. Such migrations upset standards, sterilize better stocks, increase low types, and compromise national futures more than war, revolutions, or native deteriorations." Here we enlarge the problem bewilderingly.

Undoubtedly the incursion of the Japanese is part of a much larger problem, namely, the submergence of the old racial stock of the American people by alien breeds, not only from Asia but also from Europe. Immigration from south-eastern Europe has replaced that which formerly came from the races akin to the founders of the United States. It is true, the European assimilates better with our stock, but as the immigration comes now chiefly from countries not in a condition of healthy vitality and from peoples in a backward stage of development, these late additions to our native stock have a low genetic value. The Japanese that come to California—we do not speak of the higher classes—are superior to the lower type of European and they are incompatible genetically with our people, so that there is less miscegenation. The birth-rate among the descendants of those who founded this republic is declining to a deplorable degree, whereas the incoming foreigner is prolific. We must face the fact that the American type developed before the Civil War is being degraded by an influx of uncongenial aliens; the original stock is being overwhelmed by immigration from both directions, from across the Atlantic as well as from over the Pacific. The destiny of the United States is overshadowed by the possibility of a tragic catastrophe. The Anglo-Saxon and Anglo-Celtic elements, which it is the fashion now to term Nordic, but which to us are typified by the Virginians and the New Englanders, the original settlers of America, men of the idealistic and energetic Elizabethan type, are being swamped by the incoming tide of alien and lower breeds, bringing customs, traditions, and standards of living discordant with the aims and ideals of this republic.

Stores in Mining Communities

Small events may be interesting on account of their significance. For instance, within the last few weeks the two general mercantile stores at Ruth, Nevada, have been closed, permanently, after a number of years of flourishing business that proved highly profitable to their proprietors. The underground and open-pit mines of the Nevada Consolidated Copper company are at Ruth and until a few months ago the employees of the company purchased a large proportion of their food-supplies as well as some shoes, clothing, hardware, and drygoods from these two local merchants, the next nearest market being at Ely, ten miles down the canyon. Neither the mining company nor any of its officials were even indirectly interested in either of these stores; nor was there any desire on the part of the company to influence its employees to patronize any one store or market in preference to another. The miners were absolutely free to buy what they needed where they could get the best price, and, in the face of what competition existed, the two stores at Ruth were prosperous. The employees, however, felt the increasing pressure of rising prices, and accordingly the company last summer started an 'Employees Commissary' to distribute at cost some of the staple provisions. While the plan was an experiment at first it was supported so enthusiastically by the employees that the variety of the stock was increased to include practically every kind of food, in addition to sundry other household supplies, shoes, and some kinds of clothing. There are now two stock-rooms, one at Ruth for the benefit of the community about the mines, and the other at McGill, where the mill and smelter employees are supplied. The saving to the average man with a family amounts to fully 25% of what he formerly paid. The employees them-

selves have a voice in the administration of the commissary in that they select the directors, subject to the approval of Mr. C. B. Lakenan, the general manager for the company. The business is financed by the company but is conducted with the sole aim of supplying the employees with the things that they require at cost; they get the advantage of efficient buying in large quantities, and in large markets, by competent men. A novel feature, and one that reduces the cost to the consumer, is the method of distribution at the mine. On the first and fifteenth of each month an 'order-blank and price-list' effective for the ensuing two weeks is printed, and several thousand copies are distributed at the various time-offices. The prices for each article are figured from the net cost of the material, plus freight, and the actual expense of distribution. It has been found advisable to establish and publish a definite price beforehand rather than to oblige the housewife to do her ordering and then wait several weeks to know exactly how much she has spent. The practical result is virtually the same and it is much more comforting to the purchaser, who is usually a woman. Completed orders must be turned in at the time-office or at the commissary on or before the 8th or 23rd of the month and deliveries are made on the 10th and 25th. We venture to suggest that the need for anticipating one's requirements for a fortnight in advance has stimulated efficiency in household economy; perhaps it has helped to develop more than one household-engineer; it is the beginning of a budget system, such as Uncle Sam needs. There are no losses due to bad accounts because payment is made through the time-office by deduction from the employee's pay-check. Coupon-books are sold to enable small purchases at any time between delivery-days, but the customer must carry home her own merchandise, so only a small proportion of the business is done in this way. The commissary has been in operation about four months, but its success is attested by the promptness with which the two merchants found it advisable to discontinue their business.

This is but typical of the prevailing conditions in mining as well as other industrial communities today. The Judge Mining & Smelting Company has just moved a stock of goods that it lately has carried for the benefit of its employees to a larger and more conveniently situated store-room in the business portion of Park City, in Utah. Here coupon-books are to be used exclusively. Only employees of the Judge company and its subsidiaries are to be served; in the event of a man leaving the company his book is cancelled and the remaining coupons redeemed. Mr. O. N. Friendly, the general superintendent, has recently added coal to the list of things that can be purchased. He is confident that he will deliver coal in two-ton lots to the homes of his employees at a saving of $4 per ton over the retail price of the local dealers. This is a considerable item in a country with a winter climate like that of Park City. Mr. Friendly emphasizes the advantages of systematic buying in larger quantity; also he believes that the employees are influenced, perhaps unconsciously, to improve the character of their bill of fare by being offered good grades of substantial and wholesome food. Shoes are sold at prices 35% below those prevailing in most places. The store is conducted by the company, with no co-operative features, but the prices are only 5% above the wholesale cost and there is no intention on the part of the management to derive profit from the business. In the mining towns of Arizona co-operative stores are numerous. An idea that seems to be popular there is the 'dividend' plan. At intervals of three or six months the accumulated profits are distributed among the employees who are still on the company payroll. Some of this 'dividend' money has come from non-employees who trade at the store, and from former employees who have left the service of the company during the last dividend period and thereby lose their interest in the profits; but most of it is the profit resulting from the purchases that they themselves have made. It would, of course, be possible to price the merchandise so that no appreciable surplus would accumulate, but there is doubtless a satisfaction, psychologically akin to the trading-stamp mania, in getting $50 or $100 in a lump sum, even if it is your own money. The deferred rebate, for that is what it amounts to, serves to hold an employee on the job, and from the company point of view, it is desirable on that account. Whatever may be the details of the scheme, the object is always the same, namely to assist the employee by affording him an opportunity to buy many of the things he needs at the price for which the company can purchase at wholesale. Looking back ten or fifteen years, one recalls the company store as a decidedly profitable part of many mining enterprises; indeed, concerning some we may safely say that the net earning from the store, with a monopoly of the trade, even exceeded the profit accruing from the output of ore. We recall a camp in Nevada where there were several independent merchants; the new employee was always advised by his foreman to start an account at the company store. He might be discharged for good reasons, but he was sure to be discharged, if he patronized one of the competing establishments. However, a policy such as this antagonized the men; it was contrary to their ideas of independence. The more progressive managers began to realize that the ill-will created had a bad influence on the employees and that the result was a low morale. Gradually the company store began to be replaced by independent merchants; mining companies frequently encouraged two outsiders to start stores so that there might be competition, with consequent benefit to the employee. Then came the War, with its era of inflated prices, and the contest to keep wages from falling too far behind the cost of eating, sleeping, and clothing oneself. The logic of the situation called the company back into the store business, but on a different basis from that of former years. A bona fide reduction in the cost of living is equivalent to higher pay; the mining company, by introducing a scheme of organized purchasing and efficient distribution, has avoided the necessity for further increases in wages. A successful commissary represents the application of engineering principles.

The Human Factor in Mine Management

The Editor:

Sir—Recently* I had occasion to comment on the important rôle played by the resident manager in determining labor policies in our industrial establishments and the importance of his acquiring a proper background. The fact was emphasized that more and more such managers will be recruited from the ranks of graduates of technical schools who have the responsibility of furnishing that background. This is, of course, conspicuously true in the mining industry. There are some important exceptions where laymen have been put in charge of large mining operations, but this is merely evidence of the defects in the training of engineers to which I alluded.

In the discriminating review of my article that appears in the editorial columns of your September 25 issue, you mention that "the manager of a mine discovers only too often that his directors, even engineers who have developed into successful financiers, are out of touch with working conditions, because these have changed since they themselves were in charge of operations. By living in large cities, by associating with a different class, by lack of contact with working-men the head official of a company lose the ability to understand labor conditions; so that the manager may find himself sometimes out of sympathy with them. They should realize their detachment from the work and give him a free hand."

The very point I wish to make, however, is that the technical manager himself when given such a free hand is only too apt, because of the defects in his training, to prove unprogressive and unskilful in the handling of human beings. There are some directors and executives in large cities, it is true, who, by lack of contact with the working-men "lose the ability to understand labor conditions". On the other hand, however, residents of large cities do have the advantage of contact with what is going on in the world at large, with modern economic and sociological tendencies, and with innovations that have proven successful elsewhere. The resident manager, on the contrary, is isolated and does not have the advantages of such contacts. Unless he has had his broadening training while at a technical school, he may be less liberal in his general outlook, less open-minded in his willingness to try out new methods in personnel management than the financier or head official in the home office. A mining camp is particularly apt to be cut off from the community and this immunity of the resident manager to outside influences is therefore exaggerated in mining administration.

This very isolation of the mine manager causes him usually to be given more latitude than is given managers in other industries. Thus if he be liberal in his ideas he is apt to be free to institute any progressive policies, he may decide are wise, no matter what the temperament of his head officials. On the other hand, the most liberal board of directors is powerless to initiate a modern program in the handling of labor if it cannot obtain a manager who combines technical qualifications with a grasp of modern methods of getting the co-operation of employees. A certain engineer with an international reputation, both professionally and as a liberal thinker, related to a number of us his experience and that of his associate directors in having to dismiss two or three managers in a certain manufacturing establishment, because of their inability to find one man who combined both these qualities. In conversation with a well-known labor expert who served as labor manager with a large mining company, I was interested to hear him relate the difficulties he encountered in getting the superintendents and general managers of the several plants of that organization to co-operate with him or to adopt the modern methods it was his duty to install.

Let us take a concrete example: Suppose the directors have decided to adopt a modern employee representation scheme. Unless the resident manager is sympathetic and has studied such plans elsewhere, unless he affirmatively wants it and knows how to guide it, it will be futile to introduce it over his head. If, however, the manager desires to adopt such a plan, there is a reasonable chance that the executives at home will not interfere with him. It is true that the whole tone of an organization is largely colored, as is commonly said, by the temperament and attitude of the 'old man on top', but the administrators in the field can exercise considerable independence of action if they have the ability and background to act on their own initiative.

Aside from the relative responsibility of the staff men at home and the manager in the field, mining administration from the top down, perhaps more than any other industrial administration, is in the hands of the engineering profession. As Mr. Hoover with his usual penetration has said in his 'Principles of Mining', written more than ten years ago:

"In these days of largely corporate proprietorship, the owners of mines are guided in their relations with labor by engineers occupying executive positions. On them falls the responsibility in such matters, and the engineer

*'The Atlantic Monthly', September 1920.

becomes thus a buffer between labor and capital."

It is indisputable therefore that engineers should not be graduated, as they too often have been in the past, with a rigid notion of the universe. A thorough background in physics, chemistry, mathematics, in mechanics, metallurgy and mining, does not equip a man to act as a "buffer between labor and capital". Some training in psychological conditions and the mental attitudes of men, particularly of unsophisticated men, some knowledge of modern sociological tendencies, some grasp of the incentives that make men act, some acquaintance with the history of trade-unions, and some understanding of the technical side of human engineering would seem to be requisite in the future administrator. Engineering educators must be made to adapt themselves to the new conditions.

It is not only a question of intellectual processes; it is also a question of the "psychological conditions" not in this case of the workmen, but of the engineer himself. As I have previously stated elsewhere, he is apt to become dehumanized by the very intensity of his application to routine study, unless there have been some counteracting influences, such as working with the men he will handle in his future career, or teaching English to foreigners under the auspices of the Industrial Service Movement of the Y. M. C. A. If necessary, a certain portion of his summer vacation, now utilized solely for geological expeditions, civil engineering, and other practice-work, should be devoted to this purpose.

The disadvantage of a mining engineer becoming dehumanized is not confined solely to his relations toward his future employees. It affects his qualifications in other respects. We must remember that only a very small percentage of men graduated as mining engineers become research specialists. A large proportion become administrators or field consultants. It is therefore most important that his intuitive processes and imagination be not paralyzed. A good mining engineer in making a field examination will necessarily use a certain amount of imagination. I am, of course, not here referring to the extravagant dreams of a promoter. It is a commonplace that all too often this quality of imagination is lacking in mining consultants. It is also important that he retain the qualities of a 'good mixer'. The very nature of the work that he is called upon to do means that his human contacts are of great importance. Very often the value of his observations in the field depends on his ability to get the confidence of certain individuals in a locality. When it comes to administration, a man certainly cannot expect to be successful in his relations with his staff if his emotional processes are inhibited.

To return to the personnel question. If an employee representation system or a shop committee be installed, it takes personal leadership to make it an entire success. Where there are relations with trade-unions to be faced, a manager with good human understanding and tact can prevent much friction. If it is important to overcome the objections of drill-men to use 'one-man' in place of 'two-men' drills, only a persuasive manager can do so. Leadership after all is a pre-requisite in securing *esprit de corps* in a mining organization, just as in any other organization, industrial, military, social, or political; and leadership is difficult in the absence of imagination and capacity for emotional interchange. Let me here quote from the statement of a well-known engineering educator, Professor Walter Rautenstrauch. He says, in describing a new course in Industrial Engineering at Columbia University of which he is in charge:

"Within the last few years there have been a great many schemes advanced under the heading of industrial democracy, welfare work, and employment management. While attention will be given to the influence of these movements, care will be taken to point out that no plan . . . can ever take the place of the human basis, upon which industrial enterprises must be successfully managed.

"If the spirit existing between the management and the men is not properly founded, no scheme or method can overcome this defect. The manager must be intensely human . . ."

Of course, there is a great deal in a native capacity, but a native capacity can be spoiled or developed. On the other hand, even taking it for granted that a manager retains a pleasing personality, which equips him for leadership, he is apt to ignore the personnel problem if his professional interest and enthusiasm have been mainly focused upon the physical problems. I know of a case where an engineer-manager with a naturally fine personality for leadership balked at making certain useful experiments along personnel lines because, as he frankly put it, he considered the physical problems of greater importance and did not wish to waste his time on the human ones. Nor could he be persuaded to delegate them to others.

After all, it is not merely a question of a personal success or the advantage of the particular establishment. Engineers, as well as laymen, have a serious responsibility toward society in assisting in the solution of our vexing industrial problem, which many astute thinkers regard as the gravest problem that faces our social system. It is of the utmost importance that the engineer retain his perspective, and, with his traditional objectivity of approach, do not allow himself to be swayed by class intolerance. In his relation to the question of collective bargaining or trade-unions, he should judge the particular situation and decide for himself, undisturbed by any preconceptions, whether the union leaders will assist or retard the welfare of his organization. I cannot here do better than again quote from Mr. Hoover:

"As corporations have grown, so likewise have the labor-unions. In general, they are normal and proper antidotes for unlimited capitalistic organization.

"Labor-unions usually pass through two phases. First, the inertia of the unorganized labor is too often stirred only by demagogic means. After organization through these and other agencies, the lack of balance in the leaders often makes for injustice in demands, and for violence to obtain them and disregard of agreements entered upon.

As time goes on, men become educated in regard to the rights of their employers, and to the reflection of these rights in ultimate benefit to labor itself. Then the men, as well as the intelligent employer, endeavor to safeguard both interests. When this stage arrives, violence disappears in favor of negotiations on economic principles, and the unions achieve their greatest real gains. Given a union with leaders who can control the members, and who are disposed to approach differences in a business spirit, there are few sounder positions for the employer, for agreements honorably carried out dismiss the constant harassments of possible strikes. Such unions exist in dozens of trades in this country, and they are entitled to greater recognition. The time when the employer could ride roughshod over his labor is disappearing with the doctrine of *laissez faire*, on which it was founded. The sooner the fact is recognized, the better for the employer. The sooner some miners' unions develop from the first into the second stage, the more speedily will their organizations secure general respect and influence."

It would be presumptuous to make too definite any suggestions to educators as to how the purely technical education of a mining-man's training should be supplemented. Developing qualities of human leadership and arousing the imagination of students is a subtle process and must be left to individual ingenuity. It is here a matter of stimulating innate qualities. If the student is wholly deficient in capacity for leadership perhaps it would be best to frankly advise him not to follow an administrative career. In any event his interest in human psychology should be aroused by both theoretical work and practice-courses. The Industrial Service Movement of the Y. M. C. A. is furnishing opportunities for students to gain direct contact with industrial workers through teaching English and citizenship to foreigners, and leading technical classes of workmen. It is probably largely a question, however, of the spirit and general approach which permeates the entire course. As suggested in your editorial review, it may be well to have among the instructors men who have had experience in handling workmen successfully.

One concrete suggestion that I would like to emphasize is that the curricula should be revised so that even at the sacrifice of a certain amount of instruction in purely technical subjects an adequate number of hours be devoted to psychology, social economics, welfare work, and the modern technique of handling labor. There is an imposing literature to which mining engineering students should be given an adequate approach. To enumerate at random a few of the more technical subjects which this literature includes: there are the employment, placement, training, and proper 'upgrading' of the worker, individual production records and other methods of arousing interest in work, job-analyses, motion-studies, study of labor turn-over, payment-methods, foremen-meetings, training for foremanship, health, safety, housing, and community-work programs, and shop-committee organization. The main purpose in this connection should be to indicate to the student that such a literature exists, teach him where he can find the authorities, and, what is most important of all, awaken his professional interest. Thus when he becomes a mine-manager he will take a similar interest in them that he does in technical matters and will be anxious to make sane experiments along these lines. If he has not the time to devote to every aspect of the personnel problems of his organization, he will delegate those which he cannot personally handle to specialists realizing the importance of having no phase neglected.

And last, but not least, the mining engineer should be taught to approach such controversial subjects as collective bargaining and trade-unionism in the scientific and liberal spirit of Mr. Hoover, so that he may not be swayed by mere shibboleths and catchwords.

New York, October 18. SAM A. LEWISOHN.

War Minerals Relief

The Editor:

Sir—As the founder of the Pacific Tungsten Company, whose operations were of sufficient magnitude to justify the expenditure of a large sum of money during the late war, which expenditure was a matter for consideration by the War Minerals Relief Commission, I have pleasure in stating that the claim for relief under the War Minerals Relief Act was settled in double-quick time, once the Commission had all the information before it and was in a position to decide the many points of detail with myself, which under no other circumstances would have been settled.

I found the Commission willing to meet my company's claim fairly and squarely, once, as I said before, all the information available was before it. I wish to say here that I found the Commission not only willing but eager to settle the claims. The courteous treatment by this Commission is indeed commendable, and I feel it my duty as president and general manager of the Pacific Tungsten Company to express myself in the above terms publicly.

After understanding the magnitude of the work before the Commission, it is my candid belief that the so-called alleged delays in the settlement of claims are mainly due to the Commission not having before it all of the facts surrounding each individual case, and I do believe that the Commission deserves commendation by the claimant, because the Commission itself is restricted from dealing with certain items included in the claims, thereby creating considerable dissatisfaction to some claimants who have not received what they consider is due them.

My contention is that the purchase of property and leases should not have been eliminated from the claims, neither do I think that the full amount in all cases should have been returned to the claimant through the War Minerals Relief Commission; but I do think that this matter should have been left to the Commission to be dealt with as each case warranted, because it is impossible to produce war mineral unless the lease or property purchase was at some time made, upon which property so purchased, milling and other reduction plants were con-

structed at considerable cost to the claimant, which plant, etc., comes within the range of the Commission for settlement. However, the War Minerals Relief Commission has had all of this eliminated from any consideration by them, no matter what we may claim is our just reward. The War Minerals Relief Commission cannot be blamed for not having the power to consider property purchases and leases out of their jurisdiction.

San Francisco, October 22. W. J. Loring.

Iron and Steel in India

The Editor:

Sir—Recent discoveries of iron ore in the south of the Singhbhum district would point to the iron-smelting industry of India assuming far larger proportions than at one time seemed likely. At the present only two works of any size are in operation, the Tata Iron & Steel Co., at Jamshedpur, and the Bengal Iron Co., at Kulti. The former now draws its ore from the Gurmaisini hill in Mourbhanj State where the average quality is Fe 61%, P 0.08%, S 0.03%, SiO_2 4%, but has further deposits at Okampad, Badampahar, and other places, some of which are of higher grade but require railway connection before they can be worked. The plant at Jamshedpur consists of three blast-furnaces, open-hearth furnaces, blooming, rolling and bar-mills, sulphuric-acid plant, and coke-ovens, but various extensions to the present plant are now being carried out and subsidiary industries that require iron and steel are springing up around the works. The sulphuric acid used is made from imported sulphur, but the Burma Corporation is erecting works in the neighborhood to treat its zinc concentrate, and so supply India with the acid and spelter she requires for the further development of her industries.

The Bengal Iron Co. after an abortive attempt at making steel from the ironstone of the Barakar and Raniganj series and the magnetites of Singhbhum now confines itself to pig-iron and castings. For this purpose it uses hematite from Pansira and Buda hills near Manharpur in the Kolhan estate and magnetite-apatite ore from Dhalbhum. Some ten million tons, averaging Fe 64%, P 0.05%, Mn 0.06%, SiO_2 3%, are estimated to be available in the first two deposits, but the quantity of the latter is small.

The discovery of the newer deposits has led to the formation of the Indian Iron & Steel Co. with a capital of Rs. 3 crores, which is now erecting works at Asansol on the East Indian Railway close to the coalfields. Various Calcutta firms have taken up portions and the Workington Iron & Steel Co. is also interested in this ore-field. This has led to the Bengal-Nagpur Railway building a branch line 70 miles long from Amda on the main Calcutta-Nagpur line to Jamda in the south of the Kolhan, which should be open to traffic about the end of next year.

According to recent reports, very large quantities of ore, running possibly into thousands of millions of tons, are available, and these deposits have been followed into the neighboring States of Bonai and Keonjhar, where extensive orebodies were previously known to exist, but have not yet been worked owing to lack of communications. These occurrences are similar to others found in Singhbhum and Mourbhanj, all being associated with the Archean quartzites, phyllites, and slates of the Dharwar series, the iron ore capping the highest hills and ridges of the area and existing as float on the flanks. The average iron content seems to be about 64%, but samples from the better parts of the deposits contained as much as 68% Fe with phosphorus about 0.06% and sulphur 0.02%. Large quantities of both limestone and dolomite are obtainable for flux from the Kaddapah series in the State of Gangpur some 40 miles to the west. These are situated close to the main line of the Bengal-Nagpur Railway and are already being worked by the Bisra Stone Lime Co. and the Tata Iron & Steel Co., while coking-coal, though somewhat high in phosphorus, is obtainable from the Raniganj, Jharia, and Giridih fields.

Firebrick and silica brick are manufactured locally from the Gondwana fireclay and Dharwar quartzites, while chromite and bauxite are both available within reasonable distances. All magnesite, however, has to be imported from the Salem district of Mysore, which also supplies some of the chromite used. The only necessities not indigenous to the country are sulphur and fluorspar, and, though the Burma Corporation will supply the former need, no workable deposit of the latter has yet been found in India. Small quantities are known to exist in Rajputana, Central India, and Burma, but the supply is insufficient even for present needs which amount annually to about 300 tons.

E. F. O. Murray.

Asanboni, Singhbhum, India, September 9.

Only a large deposit of mica favorably situated with regard to transportation and a grinding-mill can be probably worked solely as a source of scrap mica for grinding. Most mica mines must also yield good sheet mica to make the mining profitable, according to the U. S. Geological Survey. Mica to be of value as sheet must yield rectangles at least one and a half by two inches, which must split easily and evenly, be free from cracks, markings, and other fracture lines, and be reasonably free from specks or foreign mineral matter. The size stated is the smallest rectangular size which is salable as uncut sheet and the rough-trimmed mica sheet must be nearly twice as large to yield the rectangle stated. In order to be profitable most deposits must also contain some mica larger than this. If mica did not usually contain much foreign matter and did not have so many fissures and imperfections—cracks, markings, and holes—there would be no difficulty in obtaining all the mica needed. But there is only a very small percentage of sheet mica which when finally prepared is of the proper quality to be used in the industries. Good sheet mica should be so flexible that a sheet a thousandth of an inch thick can readily be bent into a cylinder one-quarter of an inch in diameter. The production of mica in the United States ranges from 3000 to 5000 tons per year.

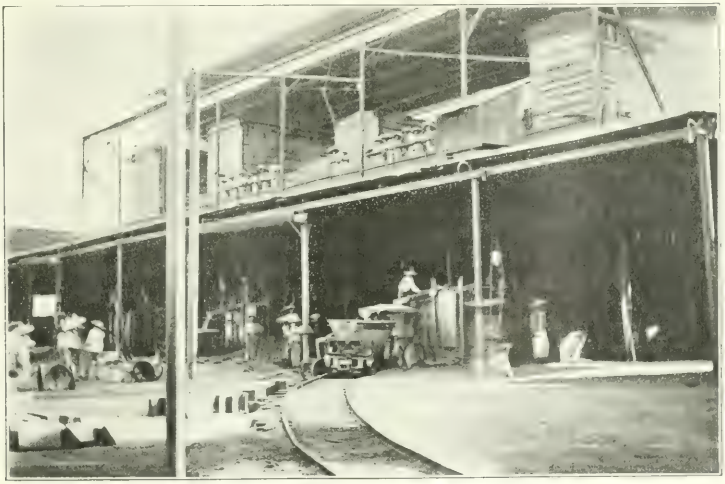
THE SALTILLO LEAD SMELTER

Metal Prices and Mining in Mexico

By H. G. NICHOLS

When the world went to war, the extent to which the influence of relativity was to make itself felt upon such time-honored questions as 'What is Ore', was possibly not considered, but to the mining engineer, cherishing utopian dreams in which technical considerations might pertain, unassailed by the demands of sordid finance, the resultant fluctuations in the metal market have brought home the realization of his dependence upon prices, to give a satisfactory and all-embracing answer to this question.

I have been engaged in a Mexican district where I was simply asked to produce ore in sufficient quantity and of a grade in copper, lead, silver, gold, and zinc, that was 'ore' in an accurately economic sense. The mineral products from the various mines were in the form of carbonates and sulphides of copper with a gangue high in lime, carbonates and sulphides of lead and zinc, cupriferous sulphide of iron, and a silicious silver compound. The problem was faced from the dual standpoint of lead and copper smelting, with a side issue in



THE COPPER SMELTER AT CONCEPCION DEL ORO

the shipment of zinc ore. The lead-smelting question was not unduly involved, given the necessity for outside purchase of limestone for flux, and apart from the ever troublous consideration of fine. The copper-smelting side of the operations should have been simpler, as with an abundant supply of pyrite the general mine-product was self-fluxing, and the furnace charge was made up approximately as follows:

		%
From A group,	Copper mines	73.0
B group,	Lead mines (silicious silver ore)	4.5
C group,	Pyrite mines	22.5

The approximate analysis of the run-of-mine from A group was as follows:

	%
Insoluble	32.5
FeO	13.0
$CaCO_3$	51.0

and by a process of screening, crushing through a Gates crusher, and sorting on a picking-belt, a shipping product, amounting to about 60% of the original tonnage, was obtained having approximately a composition of

	%
Insoluble	32
FeO	13
$CaCO_3$	50

in which the grade of copper was increased about 54%.

The run-of-mine from B group had an approximate gangue composition of

	%
Insoluble	30
FeO	16
CaO	3

from which could be separated:

1. A zinc product sufficiently clean for shipment.
2. A lead product with approximate gangue composition of insoluble 25%, FeO 16%, CaO 3%, with from 1 to 2% sulphur, and containing zinc and silver, with some copper.
3. A silicious silver ore with 48% insoluble, 20% FeO, and 2 to 3% CaO.

From C group a pyritic product was produced with a composition of approximately

	%
Insoluble	18.5
FeO	39.0
$CaCO_3$	9.0
Sulphur	33.0

and an iron ore containing 8% insoluble, 2% $CaCO_3$, and 74% FeO.

The disposition of the several mine-products was as follows:

From A group; entirely to the copper smelter.
B group; lead ore to the lead smelter.
Zinc ore shipped.
Silicious silver ore to the copper smelter.
C group; as required, to both smelters.

The products treated at the copper smelter were therefore:

	Insol.	FeO	$CaCO_3$	Sulphur
	%	%	%	%
73	32	13	50	
With native oxidized copper minerals containing gold and silver				
4.5	48	20	9	
Containing silver and gold.				
22.5	18	39	9	33
With some copper, silver, and gold.				

And the average composition of the mixture at this smelter was

	%
Insoluble	30
$CaCO_3$	39
FeO	19
Sulphur	8

with copper, gold, and silver contents.

The word 'ore' has been avoided so far.

In order to keep in touch with requirements for profitable working, the following equation was made use of:

$$P = \frac{(X \times (C + C') - E) \times 100}{\frac{X\,Y}{T}}$$

Where P = percentage of copper in the ore from A group, required to offset expenditure.

X = tonnage of ore from A group shipped.

C = operating mining-cost per ton shipped, that is, cost capable of being regulated by the mining department.

C' = all other costs per ton shipped.

E = value of all outside ores (from B and C groups) smelted = tons of copper contained

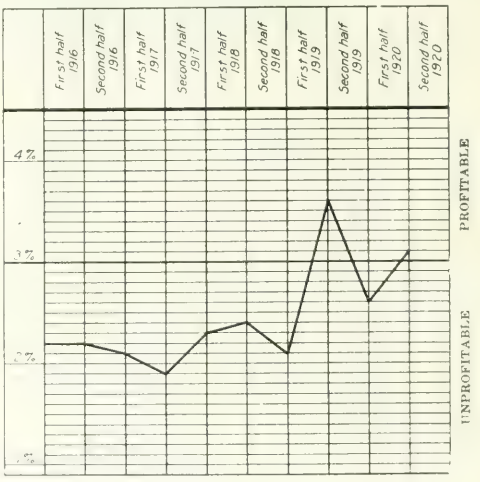


FIG. 1

× 82% extraction × current price less $0.036 per lb. freight and treatment charges on matte + oz. silver contained × 95% extraction − 2% × current price + oz. gold contained × 95% extraction × current price.

Y = value of A group ore shipped (as above).

T = tons of copper in A group ore shipped.

The object being to ascertain whether the grade of ore being shipped was coming up to the standard requirements based on fluctuating conditions. If anyone cares to take the trouble to work out this equation, taking constants for every factor except the price of metals, he will see to what extent the problem of satisfying the demands of profit-earning has been affected by this bugbear.

Assuming that considerations of mining economy have pointed to a 3% product as being desirable and that a monthly output of 10,000 tons shipping ore is required, and that this ore will contain

2.5 oz. per ton silver
0.025 oz. per ton gold

CELEBRATING THE 16TH OF SEPTEMBER

The metal-content of outside ore smelted with the above tonnage might be taken as above, at

Copper	40 tons
Silver	7000 oz.
Gold	55 oz.

and the operating mining cost at $4 per ton, the smelting and all overhead charges at $9 per ton.

With these figures the value of *P* in the equation will be represented by the dotted line in the diagram (Fig. 1) for the half-yearly periods named during the years 1916 to 1920, and it will be seen that what was profitable 'ore' at one time was not so at another.

Add to this criterion the difficulty of increasing grade by reason of unsuitability to concentration of the oxidized ore, of limitations to sorting imposed by dessemination of the copper minerals, and percentage of fine material not amenable to picking, in the run-of-mine, and it will be seen how vitally the problem is complicated by any reduction in output such as results from the recurring demands of a country prone to excitement and fiestas, not all of which are so peaceably conducted as the one shown in the accompanying photograph. This is a picture of Aranzazu celebrating on the 16th September the anniversary of the day when liberty was assured to Mexico to be—well—Mexico.

Returning to the subject of the copper-smelting operations, two points are clear from the figures of percentages, namely, first, that there is a large excess of sulphur consumed, this being due to the friable character of the pyrite from group C. By agglomeration in the cement type of rotary kiln, it is hoped to obviate a great part of this loss, which is of the greater consequence in that there is a notable quantity of copper contained in this fine product. As at present, the method adopted is to bed-down this fine pyrite with fine from group A and flue-dust, and run a low-grade matte from this charge, re-smelting the mixture with coarse ore from the shipping product. The second point is that there is evidently a constant demand for the silicious silver ore from group B, for fluxing purposes, but to the extent, dependent upon the value of the silver content, that a higher proportion of silica would be desirable. So that here again the question of price of metal comes in, and the smelterman has to temper his technical aspirations to the possibilities extended by a capricious metal market.

The iron ore from group C is not figured in the charge percentages. Smelters have need of tonics as much as human beings. It has been seen that the sorted lead ore from the company's mines delivered to the lead smelter has an approximate composition of 25% insoluble, 16% FeO, and 3% CaO. With the pyrite and iron from C group, this ore comprises from 70 to 80% of all the ores smelted. Limestone, of which there is an abundant local supply, is purchased outside, and the slag has an approximate composition of

	%
Insoluble	32
FeO	32
CaO	20

The introduction of the pyrite is in relation to the saving of the copper content of the B group ores, the ultimate products from this smelter being a lead-silver bullion carrying from 3 to 3.5 kilo. silver per ton and a copper-lead-zinc matte of an average composition of

	%
Copper	15
Lead	20
Zinc	10

which is shipped to refineries. This matte also carries about one-third of the per-tonnage content in silver of that carried by the lead bullion.

All ores are bedded and damped before charging, and the fine, which is shipped as such to the smelter, is agglomerated in a rotary kiln, as above mentioned, without previous damping. In this connection, an interesting incident comes to my mind from years ago. Casting about for adaptations of the principle of dewatering by means of assisted slime-settlement, I was attracted by the possibility of cutting down the cost of cement-making by reducing the percentage of moisture in the slurry before

passing it through these same rotary kilns, and the Portland Cement Manufacturers afforded me facilities for the erection of an experimental plant for this purpose at their works in England. The reduction of the moisture was easy enough with this ideal material, but it transpired that the satisfactory agglomeration of the cement-forming slurry was unfavorably affected by introducing it into the kilns in a state of too high consistence. It is hardly probable, however, that the demands of agglomeration of ore would run on parallel lines to those obtaining in the process of cement-making.

In the B group ore, treated at this smelter, the zinc content is often as high as 10% and is sometimes higher, resulting in matte-forming difficulties and other troubles. The use of the Darby tube type of hood with an annular charge-space of 20 inches is found beneficial as a deterrent to the formation of wall accretions in the furnaces, by keeping the coarse material toward the centre. It may be gathered from the foregoing that this smelter is run for the purpose of producing lead bullion as such, and not as a producer of silver-lead bullion, in which the lead would act more particularly as a carrier, and the extent to which this principle is followed is dependent upon many factors, not the least of which is, again, the price of silver. It has been seen that high-grade silver ore at present is diverted from the B group of mines to the copper smelter, the reason for which is that the high silica-content of this ore is a desideratum at this smelter, while in the lead smelter it would only entail the loss of lead. If there were no copper smelter available, then this silicious silver product would be a drug on the market, because its silica content would entail a greater loss of lead in smelting than the value of the silver would compensate. With a higher silver-value, it is conceivable that the lead might be relegated to the status of a carrier and a certain loss in that metal might be justified.

The point is still further emphasized by the possibility of change in the character of the ore as further depth is attained in the mines of this district. Already a mixture of lead, zinc, and copper sulphides has been found in the mines of A group, and the question of what can be considered as 'ore', profitably to be treated, in either lead or copper furnaces, may depend largely upon the results to be obtained by water concentration and the relative market-value of the metal constituents of each product. In such a case, who can say to what extent the price of metals might determine the distribution of the mine-products and the principles upon which the schemes of treatment would be affected to the end that the definition of profitable ore be established.

The Alsatian potash deposits extend between Mulhouse, Cernay, Soultz, and Ensisheim, with a total area of 124 square miles and an average thickness estimated at about 14 ft. 9 in., with an estimated tonnage of 1,472,000,000 metric tons of salts containing 300,000,000 metric tons of potassium oxide (K_2O). The deposits are 14 miles long and 6 miles wide, east to west. The basin has been affected by the formation of the Rhine valley, and it is thought to be a result of the lagoon state of the region during the Oligocene period. The potash layers are in the centre of a salt formation in two parallel layers, the upper one being 1 ft. 3 in. to 3 ft. 9 in. thick, averaging 25% potassium oxide and the other one, 65 ft. deeper, 11.4 to 13 ft. thick, averaging from 17 to 25% of potassium oxide.

What She Thought

Lawrence F. Sherman writes in 'Forbes Magazine': John (a bricklayer) and Mary, his wife, were seated at the breakfast table in their cozy home on Berger avenue in Pittsburgh, Pennsylvania.

John had attended a meeting of the Bricklayers' Union Local No. 0964 the evening before, and as he swallowed the last drop of Java he remarked to Mary:

"Did you ever hear such nonsense? Up at the hall last night Delegate Brown told us the 'Big Four' of the Farmers' Organizations, with some 5,000,000 farmer members, have declared against strikes and are only going to raise enough food to eat themselves. Why, Mary, if they should only grow enough for themselves—the people in the cities like us would starve!

"When Brown stopped talking almost everybody in the hall wanted to speak. In the end they passed a vote that 'the farmers had no such right to cut down their production of food products and refuse to supply the wants and needs of us people'. That is what we did, and every local throughout the country will do the same."

Mary's eyes were flashing as she spoke: "Maybe you're right, John, but I don't see why the farmer hasn't as much right to refuse to work from dawn to dark as you have. When we first came here a few years ago and before you joined the union you used to lay 1500 to 1600 bricks a day and got $3.50, and everybody had a place to live in. After you joined the union it didn't allow you to lay so many bricks, and every little while you were home on strike for shorter and shorter hours, and now you can work eight hours in a day and the union will fine you if you lay more than 400 bricks a day. Just think of it, John, and all the people that can't get houses to live in because you and all the other union men are not building as many houses as you ought to.

"Of course, you get $9 a day now, but it costs so much more to live we can't save any more than we used to do.

"No, John, the trouble is not with the farmers. All you union men have gone plumb crazy. You won't work yourselves or allow other men to work as you ought to do, and the farmer can't get help to raise food. The trouble is with yourselves, and, take it from me, if you and all your friends up at the hall don't get busy and change your tune from: 'Strike, strike, STRIKE!' to 'Work! work! WORK!' in mighty quick order we sure will starve."

John looked kind of puzzled as he rose to go.

"Good-bye, John, and don't forget to bring home some seeds tonight so I can have a garden to keep the children and me on."

THE MINE, THE MILL, AND THE CYANIDE PLANT AT THE EXTREME RIGHT

The Mine and Mill of the Belmont Shawmut Mining Company—II, The Mill

By ARTHUR B. PARSONS

When the Belmont Shawmut company acquired the property two treatment plants already existed. The first was equipped with 100 stamps, amalgamating plates, and vanners for gravity concentration, while on the opposite side of the canyon was a chlorination plant where a limited quantity of concentrate had been treated with some success. The new company decided to remodel the concentrator to produce a high-grade product for shipment to the smelter without local treatment. However, the remodeled plant had not been in operation long when freight and treatment charges began to climb, and certain penalties were imposed by the smelting company, so that the cost of marketing became prohibitive. Taking into consideration the discounted price at which the gold was paid for, it cost practically $16 per ton to realize on a $60 concentrate; and since the concentrating ratio was 9:1, this added $1.55 per ton of ore to the cost of operation. Accordingly it was decided to utilize the roasters in the old chlorination plant in the furtherance of a scheme for cyaniding the concentrate. Exhaustive tests made by the metallurgical staff demonstrated the practicability of such a treatment, and determined the details of the process. The chlorination plant was remodeled, and cyanidation was commenced early in 1920. The result has been satisfactory in that bullion has been produced at a gross cost of approximately $4 per ton of concentrate as compared with the $16 required under the former plan. Of this gross deduction one-fourth, roughly, is the cost of treatment and three-fourths is the unrecovered gold in the tailing.

The combined gravity and flotation concentration will be described first. The average ore as it comes from the mine contains approximately 7% sulphides, mostly pyrite, with which is associated gold to the value of $5 per ton. The small proportion of free gold follows the sulphide in milling so that the problem is essentially to separate the pyrite from the gangue, which, besides silicious constituents, contains dolomite and a considerable proportion of talcose minerals.

Under normal conditions, 400 tons of ore crushed to pass a 2-in. ring is delivered daily, directly from the mine-cars, into a 2800-ton flat-bottomed bin behind the stamp-batteries. See the accompanying flow-sheet. There are twenty 1250-lb. and fifty 1050-lb. stamps, the lighter being fed by suspended Challenge feeders, while platform feeders of Challenge type supply the 1250-lb. stamps. The mortars were manufactured by the Union Iron Works and are placed on massive concrete mortar-blocks with a $\frac{1}{4}$-in. rubber pad intervening. The mortar-block for the entire 70 stamps constitutes a monolith. The liners of the mortar-boxes are of cast-iron; the front liners are one inch thick and last four months; the back ones, $1\frac{1}{4}$ in. thick, last six months; while the one-inch end-liners also have a life of six months. Dies are likewise made of cast-iron, whereas the shoes are of hammered steel. The stamps drop a height of six inches, 112 drops per minute, and crush seven tons per stamp through a Tyler 10-mesh steel-wire screen. The screen is 14 by 52 in. and the height of discharge is two to three inches, the product being almost entirely 14-mesh and under, with a pulp-ratio ranging between $4\frac{1}{2}$ and 5 parts of water to one part of ore. The stamps, in batteries of ten, are belted with 16-in. six-ply rubber belts to a line-shaft that may be run alternatively by a 7-ft. Pelton water-wheel or by a 200-hp. General Electric induction-motor operating under 440 volts at 450 r.p.m. Power from the water-

wheel is transmitted to the line-shaft by means of a continuous hemp-rope drive, 40 strands of $1\frac{1}{2}$-in. rope connecting the two grooved pulleys. Water, of course, is much cheaper, as will be mentioned again. The stamps were already in the mill; had they not been, some other form of fine crushing would probably have been adopted, although the batteries do good work on the soft ore.

The pulp from the batteries is distributed over seven Buchart tables for rough concentration, and 18 tons of concentrate, on the basis of 400 tons per day, assaying about $63 per ton, is removed. This concentrate is clean, and the performance of the tables is highly satisfactory. They have a throw of $1\frac{1}{8}$ in. and make 245 strokes per minute.

The concentrate from these seven tables is joined by that from an eighth Buchart, to be mentioned later, and together they flow to one of three 28 by 7-ft. dewatering tanks that are filled in rotation. They are fitted with a filter-bottom composed of a two-inch layer of rock crushed to $\frac{1}{4}$-in. mesh above one thickness of cocoa-matting. When one tank is charged the flow is diverted to another, while the first is allowed to drain for 12 hours, after which further drying is accomplished by a 14 by 14-in. Goulds duplex vacuum-pump, belt-driven by a 10-hp. Westinghouse motor at 900 r.p.m. The moisture content is reduced to 3%. This seems low, but it must be remembered that there is an exceedingly small amount of slime mixed with the granular concentrate. After drying, a tank is discharged by means of a 27-ft. Blaisdell excavator, which delivers the concentrate through a hole at the centre onto a 16-in. belt-conveyor. This, in turn, empties its load onto a similar conveyor at right angles to it, delivering the concentrate to an eight-ton bin from which, formerly, it was loaded on motor-trucks for haulage to the railroad. Now this bin is the loading-station for an aerial-rope tramway that carries the material 500 ft. across the canyon to the cyanide plant for re-treatment.

Reverting to the tailing from the Buchart table: it flows to a concrete sump 8 by 8 by 6 ft., from which it is pumped to a standard Dorr duplex classifier by means of a 6-in. Campbell & Kelley centrifugal sand-pump running at 900 r.p.m. The lining as well as the runner of this pump is made of hard white cast-iron, the average life of both being 90 days. An ingenious scheme for lengthening the service of these liners was original at this plant. Before assembling, the pump-casing and liners are given a thin coat of grease and the space between is filled with concrete made of cement and sand. When the liners wear through in one or two spots it is unnecessary to replace them until the concrete also wears sufficiently to expose the pump-casing. The purpose of the oil is to prevent the concrete from freezing to the metal parts as it sets. For gritty material these Campbell & Kelley pumps are entirely satisfactory; they are simple in construction, easily re-lined, and handle the table-tailing at the minimum cost per ton.

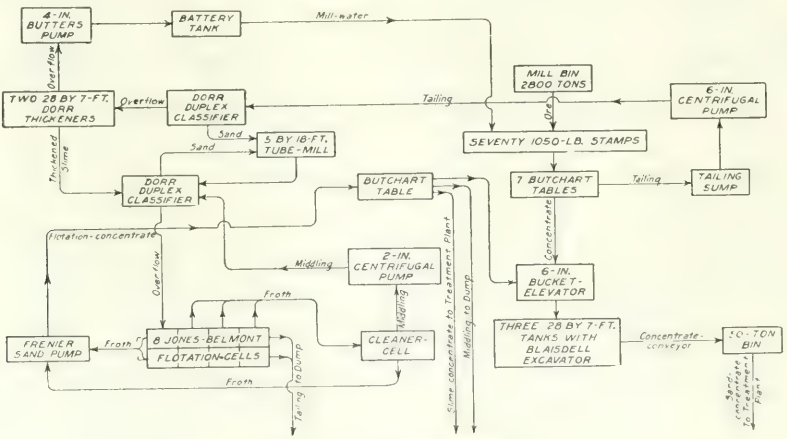


FIG. 1. FLOW-SHEET OF MILL

The slime-overflow from this first classifier is divided between two 28 by 7-ft. Dorr thickener-tanks, the rakes making one-eighth revolution per minute. The overflow from the thickeners is returned by a 4-in. Butters centrifugal pump, manufactured by Meese & Gottfried of San Francisco, to the 12 by 14-ft. wood-stave storage-tank for battery water, situated on the hill above the mill. The thickened slime, with a consistence of three parts water to one of ore, goes to a second Dorr duplex classifier which is in closed circuit with a 5 by 18-ft. tube-mill made by the Union Iron Works. This mill is driven at 29 r.p.m. from the main line-shaft to which the stamps are belted. A 36-in. Imperial clutch on the belt-driven pinion-shaft transmits power to the tube. Belmont liners are used and to date the original set has not been replaced; they have not, in fact, worn sufficiently to give a basis for an accurate estimate of their life. The best Danish flint pebbles are used, the consumption being 0.3 lb. per ton of ore stamped, when the pebble-load is carried at a point between 10 and 12 in. below the centre line of the mill. The experience that caused the maintenance of the charge of pebbles at this particular height is interest-

ing. The attempt was first made to keep the pebble-load at the centre of the tube; to do this it was found necessary to feed new pebbles at a rate of approximately 1.3 lb. per ton of ore. Considering the softness of the ore, this seemed to be high. Accordingly, the size of the pebble-charge gradually was decreased and it was found that as it diminished the quantity of new pebbles needed to maintain a given load also diminished. There was no impairment in the results, although the consumption of power increased. Apparently several hundred pounds of pebbles were being worn out daily by useless grinding on each other and on the lining when the mill was more heavily charged. A constant load carried 10 in. below the centre was decided upon as being the most economical with respect to all factors. The slime overflow from the second Dorr classifier already mentioned is the feed for the flotation machines. It has a dilution of five parts of water to one of solid, a typical screen analysis being as follows:

	Mesh	%
On	48	4.0
Through	48	11.0
"	65	10.0
"	100	8.5
"	150	10.5
"	200	56.0

There are nine standard Jones-Belmont flotation cells built in a single unit of reinforced concrete. Four cells, arranged in series, form two parallel step-like rows, while the ninth, at the bottom of the flight and at the centre, is a cleaner-cell. The Jones-Belmont machine combines the mechanical and low-pressure air principles of producing froth. The impellers are revolved at a speed of 350 r.p.m. by means of a belt-driven mitre gear running in oil; the air, with a pressure of three pounds per square inch, is introduced through special woven blankets made by the Filter Fabrics Co. of Salt Lake City. The blanket is reinforced on the under side by a $\frac{1}{4}$-in. mesh iron screen fastened with copper rivets. It seems strange that the screen backing is not placed above, rather than below, the mat, since the greater pressure is from the air-chamber. The froth from the first cell of each series and that from the cleaner flows to the pit of a 54-in. Frenier sand-pump and is thence raised to the extra Buchart table for cleaning while the concentrate from the six intermediate cells flows by gravity to the cleaner, which, in addition to a froth-concentrate, produces a middling that is returned to the second Dorr classifier from which the coarser particles are sent to the tube-mill for re-grinding. Tailing from all but the cleaner-cell gravitates to waste.

The oil used is a mixture of three parts by weight of No. 2 Cleveland Cliffs wood-creosote and four parts of Californian fuel-oil from the same tank that supplies fuel for the roasting-furnaces. For each ton of ore stamped, $1\frac{3}{4}$ lb. of this mixture is added to the tube-mill circuit. Pine-oils and other more expensive oils were experimented with, but results were not materially improved.

The use of sodium sulphide, however, is vital to the success of the flotation. The cleanest tailing that can be obtained from an ore assaying 3 oz. per ton without the use of sodium sulphide contains approximately 0.045 oz. of gold, even when given a double treatment. The same pulp, to which sulphide in the proportion of 0.50 lb. per ton of ore has been added, can readily be impoverished to 0.01 oz. gold, with the production of a decidedly cleaner concentrate. At the present time 0.25 lb. of 60% sodium sulphide is added, part to the pulp entering the cleaner-cell and part to the tube-mill. At the start 1.5 lb. was introduced, along with the oil, at the tube-mill. However, when the cost of the reagent jumped from 3c. to 10c. per pound, some way of decreasing this amount was sought. The theory on which the addition is made at the cleaner-cell instead of at the tube-mill is this: One function of the sodium sulphide is to flocculate the sulphide particles, at the same time that it deflocculates the gangue; the proportion of gangue in the pulp entering the cleaner-cell is small compared with that in the tube-mill circuit; accordingly, a greatly reduced quantity of sodium sulphide will have an equivalent opportunity to come in contact with sulphide particles to form nuclei for floatable flocks. Since the tailing from the cleaner-cell is returned to the tube-mill a certain proportion of these nuclei enter that circuit and in due course perform their function in the four-cell series. The idea is that a nucleus once formed builds up without further aid, but that the sodium sulphide initiates the structure. Whether or not this is the real explanation, or part of the real explanation, the fact remains that a saving of more than one pound per ton of ore has been effected. The sodium sulphide also has a scouring effect on the valuable mineral particles that stimulates the selective action of flotation.

Air for the Jones-Belmont cells is supplied by a General Electric centrifugal compressor, type T, form A, with a speed of 3450 r.p.m.; a 30-hp. direct-connected induction-motor operating at 220 volts, drives the compressor. This machine has a capacity of 1000 cu. ft. per minute at a pressure of three pounds and could supply 12 cells, instead of nine, if required.

The flotation concentrate amounts to 13 tons of $25 grade, still based on a daily mill-run of 400 tons per day. As mentioned before, this product is elevated by a Frenier sand-pump, which, incidentally, has performed its work to date with no repairs other than re-packing, to a Buchart table, for an additional separation. This step is necessary principally because of the talcose minerals, which naturally are inclined to float mechanically with the flotation concentrate. Three products are made, namely: two tons of sand assaying $60 per ton; two tons of intermediate product, chiefly talc, which contains $2.50 per ton and is discarded; and nine tons of slime worth about $25 per ton. The first concentrate joins the regular table-concentrate and goes with it to the three collecting-tanks and thence by way of the aerial tram to the roasting-plant. The slime-concentrate flows by gravity to the bottom of the canyon and is then relayed by motor-driven centrifugal pumps up the hill, where it is cyanided. The flotation tailing averages $0.52 per ton, making a net recovery by concentration of nearly 90%. The power consumed in the entire concentrator amounts to 19 kw-hr. per ton of ore milled and is distributed approximately according to the following table:

Department	%
Crushing and conveying	6.8
Stamping	49.8
Tube-milling	17.1
Concentrating tables	2.6
Elevating and separating	6.0
Dewatering and excavating	1.7
Flotation	14.9
Lighting	1.1

The mill crew consists of 14 men, including:

1 superintendent,
2 repairmen (general),
2 repairmen (on stamps),
3 battery-men (on shifts),
3 concentrator-men (on shifts),
3 flotation-men (on shifts).

Although the mill was remodeled it does not have the incongruities of some old plants; the arrangement of the equipment is convenient and compact. The concrete foundations are exceptionally good and the mechanical condition of the equipment is first-class, as is evidenced by the small number of operators and repairmen required.

The concentrate-treatment plant was remodeled in a hurry and is a make-shift in some respects. Roasting is done in two old Edwards No. 2 simplex roasters, 56 ft. long, run by small individual Pelton water-wheels. Each has 15 rabbles, the three near the discharge end being cooled by water circulating within them. Fuel-oil is used for firing, the present burners being of home-made construction, although it is planned to change to a low-pressure burner of the style made by the Denver Fire Clay Co. for use in assay-offices and refineries. The concentrate is fed at the rate of 6 to 7 tons per furnace per day by means of an improvised Challenge feeder. The sulphur content of the feed is 30%, while the roasted material, or 'calcine', as it is called, contains, on an average, 4.3% total sulphur, 1.2% of which is combined in the form of soluble sulphates.

The calcine is discharged into a steel car and is trammed to a bin that feeds an inclined plow-conveyor, which performs the double function of cooling and elevating the hot material. The bed is a plane inclined about 35% from the horizontal, 6 ft. wide and 75 ft. long. It is surfaced with bricks that are grouted with cement. Four sets of plows are dragged up the incline by means of two endless chains, one on either side; on the return, the inverted plows travel about three feet above the plane. This arrangement is a relic of days when chlorination was employed, but nevertheless it serves usefully in the present plant. If it is attempted to wet the calcine when hot, steam is formed and dust rises in dense clouds, whereas after cooling there is a rather remarkable absence of dusting when the calcine meets the stream of raw slime-concentrate at the top of the incline. After being pumped to the treatment-plant this slime is partly dewatered in a Dorr thickener before being elevated to join the roasted material as it flows to the Devereux agitator-vats. There are six of these, each 14 ft. high by 14 ft. in diameter. The Devereux agitator consists of a blade exactly like an ordinary boat-propeller, about 30 inches in diameter, on the lower end of a suspended vertical shaft revolving at 125 r.p.m. The propeller, or more properly the impeller, clears the floor of the vat by 2½ ft., but, except for some accumulation of heavy sand at the periphery and a small cone just beneath the blade itself, the revolving pulp sweeps the floor clean. A single diametrical baffle, consisting of a 2 by 10-in. plank with its low edge two inches below the surface of the pulp, when not in motion, prevents the pulp from overflowing the vat by deflecting the vortex caused by the rotation of the impeller. The result is a thorough aeration of the pulp by the air sucked in.

The Devereux agitators are equipped with a hinged-pipe decanter by means of which water or solution can be removed from above the settled pulp. The operation is intermittent, by charges, a typical cycle being as follows: The pulp, comprising the mixed raw and roasted concentrates, is run into a vat serving as a collector. After the excess water is decanted, sufficient lime is added to make the charge distinctly alkaline; strong barren cyanide solution is then introduced and agitation commenced. This is continued for 16 hours with the addition at intervals of the necessary sodium cyanide and lime to maintain a solution strength corresponding to one pound of cyanide and 1.5 lb. protective alkalinity per ton. At the end of the 16-hour period the charge is allowed to settle and 35 to 40 tons of solution is decanted to the gold-vats. This requires three or four hours. Following this come five 4-hour periods of agitation alternating with settling and decantation, and if the quantity of stock solution is low, a water wash may follow. The following table, showing the results of a typical charge, indicates a rapid dissolving of the gold in the early part of the treatment.

Decanted solution, tons	Period of agitation, hours	Solution assay, gold (heading)	Pulp assay gold
39	16	$9.16	...
38	4	2.79	...
40	4	1.03	...
35	4	0.43	...
40	4	0.21	...
(Tailing washed)	..	....	3.12
(Tailing unwashed)	..	....	3.50

Lead acetate is added to the agitators, the average amount being ¼ lb. per ton of concentrate, while the consumption of cyanide is approximately 1.4 lb. per ton of concentrate.

Before starting a new charge, a strong solution of ferrous sulphate is used to 'kill' any cyanide in the residual solution or pulp. This precaution is necessary because the gold in the roasted concentrate is attacked almost instantly even by an extremely weak solution of cyanide and an appreciable amount of gold might be carried away with the decanted wash-water. Tailing from the agitator-vats gravitates to the slime-tailing pond.

This successful treatment by cyanide of unroasted raw flotation concentrate mixed with an equal quantity of roasted table-concentrate is noteworthy. An extraction of only 60% with an increased consumption of cyanide is obtained on raw slime-concentrate alone. Calcined material cyanided alone yields 90 to 92%, whereas the treatment of the two combined results in a recovery of 91 to 94%. The improved extraction as compared with that obtained from treating straight calcine is easily

accounted for by the mechanical advantage of having an intermixture of slime with the granular concentrate. This simply promotes better contact of the solution by tending to keep the sand particles in suspension. Just why the combination treatment affects the additional recovery of the gold in the flotation concentrate has not

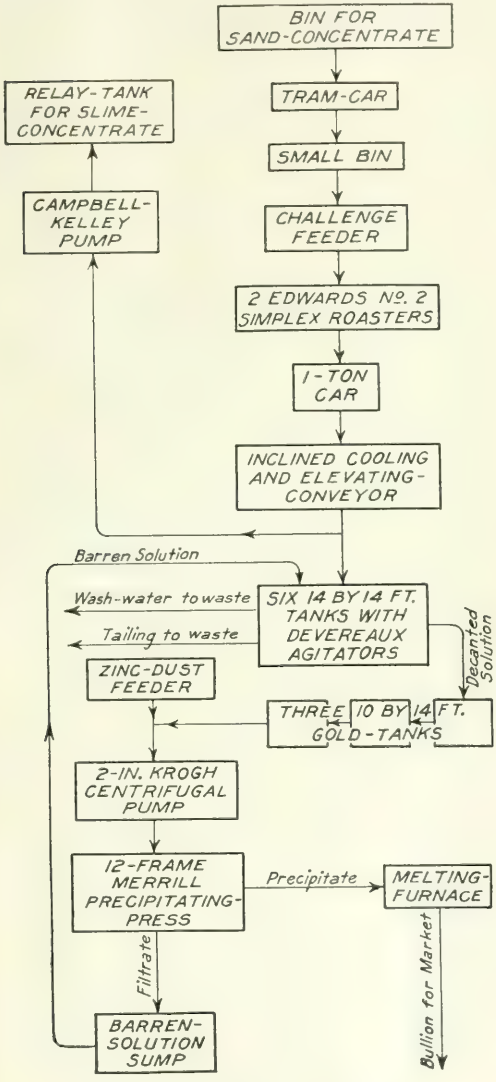


FIG. 2. FLOW-SHEET OF CYANIDE PLANT

been entirely explained as yet, but experimental work on the problem is being done. The part played by the oil is interesting, but it is apparent that some combination of conditions renders it harmless in this particular plant.

The decanted pregnant solution runs to the first of three 10 by 14-ft. gold vats, connected in series in order to afford as much time as possible for the settling of any suspended solid matter. At present there is no other provision for clarifying, but this is to be remedied, with an anticipated improvement in the behavior of the precipitating press. This is a 12-frame 52-in. Merrill press through which the solution is forced by a two-inch Krogh enclosed-type centrifugal pump instead of by the usual plunger-pump. Merrillite, a combination of dusts of zinc and lead, is fed to the precipitating line by means of a traveling belt actuated by an ingenious contrivance in which an old vanner-head is used to get an appropriate reduction in speed. The cloths become choked rapidly and the pressure goes to 15 or 20 lb. before the leaves have barely started to fill. If proper clarification does not remedy the difficulty an explanation will be sought elsewhere. This Krogh pump is direct-connected to a $7\frac{1}{2}$-hp. General Electric induction motor, while a similar pump that lifts the barren solution from a 10 by 14-ft. tank is connected to a 5-hp. Westinghouse induction motor.

Refining is done in a melting-furnace made by the Denver Fire Clay Co. and fitted with that company's low-pressure burner. A small centrifugal fan, driven by a $1\frac{1}{2}$-hp. motor, supplies the air required and comes as part of the regular equipment. The furnace takes a No. 125 graphite crucible and is tilted with the crucible when pouring is to be done. Bullion less than 600 fine is made at present, but this may be improved when the faulty precipitation is corrected.

Until two years ago operations depended entirely upon water power. For ten months in the year an adequate supply, with a head of 1100 ft., was obtainable. However, work was practically at a standstill for two months during the dry season in September and October, and this interruption was costly. Electric motors were accordingly installed, although many of the water-wheels were retained as alternative sources of motive power. Since then the shortage of water has made the use of electricity increasingly important, so that the installation of the motors was fortunate. Electric power costs $6.95 per hp. month, as compared with $2.06 for that developed by the wheels, so water is used whenever available. As mentioned before, the line-shaft in the mill may be run by water; likewise the main mine-compressor in the mill-building is alternatively belted by a 26-in. endless double-leather belt to a 200-hp. General Electric motor, or connected directly through a flexible leather coupling to a 7-ft. Pelton water-wheel. This compressor is an Ingersoll-Rand Imperial Type 10, two-stage machine, having cylinder dimensions of 22 by 16 in. and 13 by 16 in. A duplex Giant air-compressor made by the Compressed Air Machinery Co. is used as an auxiliary. It has no motor, but is driven by a $1\frac{1}{4}$-in. endless manila-rope from a 6-ft. Pelton wheel.

The present predicament of the producer of gold is indicated by the following figures, which show the actual unit increases in the various elements comprising the cost of operation, both mining and milling, in 1920 as compared with 1917. The cost in 1917 was, of course,

far in excess of that in 1914, which we consider as 'normal'.

	Proportion of total cost	Increase 1920 over 1917
	%	%
All labor	60	55
Principal supplies	33	34
Power	7	57
Total	100	48.21

The superintendent at the mine, to whom I am indebted for the data presented in this article, is O. McCraney. C. W. Wark is mill-superintendent and Byron E. Rowe has charge of the mine. Albert Silver, consulting metallurgist, supervised the experimental metallurgical work, while the general direction of the enterprise devolves upon Frederick Bradshaw, general manager for all of the Belmont companies, whose office is in San Francisco.

Use for Blast-Furnace Slag

The Germans during the War, when materials were scarce, gave a great deal of attention to the utilization of blast-furnace slags. 'Nature' states that a new use for slag is foreshadowed in Germany, that is, for the manufacture of light bricks for building purposes. By passing molten slag horizontally through water, the steam generated blows out or extrudes the slag-jet, and forms what the Germans term 'spume' slag or artificial pumice-stone. This material has been patented under the name of 'thermosite', owing to its excellent heat-insulating properties.

The patentee has also invented a press for pressing bricks formed of small pieces of this artificial pumice and a mixture of slag, sand, and slaked lime which is used as a binder. The bricks thus formed are strong and light, and resemble in their properties the tuff obtained in the neighborhood of Andernach. As in addition they can be pressed to large dimensions, less mortar will be required in building operations. The German authorities have approved of the new type of brick for house-building.

Gold and Silver Production of Ontario

*Ontario's position as a producer of gold is becoming increasingly important. For the first half of 1920 the output was nearly 22% greater than the 1919 production. Production of gold by individual mines is presented herewith:

Porcupine	
Hollinger	$2,928,079
McIntyre	1,085,298
Dome	989,566
Porcupine Crown	70,017
Dome Lake	46,809
Northerown	31,019
Davidson	13,489
Kirkland Lake	
Lake Shore	243,977
Kirkland Lake	137,676
Teck-Hughes	125,137

From miscellaneous mines the output was $17,138, of which the Argonaut in Gauthier township contributed $13,938. There was also a recovery of gold worth $2498 from nickel-copper refining operations. In addition gold mines produced 49,156 oz. of silver worth $56,364. During the period 673,694 tons of ore was milled—the milling capacity at Porcupine at the end of June was 5296 tons and at Kirkland Lake 330 tons daily.

During the period a total of 4,474,322 oz. of silver worth $5,077,028 was marketed. Of this total 225,513 oz. came from the Miller Lake, O'Brien, and Castle properties at Gowganda, 23,414 oz. from nickel-copper refining operations and 49,156 oz. from gold ores. Some producers of silver were paid for the cobalt content of ores, concentrates, and residues marketed. In all $138,317 was received for 296,116 pounds.

*Ontario Bureau of Mines.

Mineral Production of Arizona in 1919

Advance Figures by VICTOR C. HEIKES, U. S. Geological Survey

County	Number of producers	Ore, short tons	Gold,* fine ounces	Silver,* fine ounces	Copper, pounds	Lead, pounds	Recoverable Zinc, pounds	Total value
Cochise	43	1,377,207	45,498.53	2,421,905	126,483,923	4,851,238	.....	$27,436,198
Coconino	2	103	0.43	664	32,507	.....	.....	6,799
Gila	46	6,374,240	7,900.17	439,647	176,527,981	94,526	.....	33,494,930
Graham	4	2,456	2.80	16,320	46,385	670,814	.....	62,517
Greenlee	14	1,301,199	3,386.35	106,241	44,867,643	1,294	.....	8,534,443
Maricopa	6	157	36.18	379	19,924	65,060	.....	8,326
Mohave	40	201,040	124,920.26	164,517	302,667	916,818	.....	2,871,477
Pima	29	1,652,324	70.00	40,655	43,805,491	489,886	.....	8,221,324
Pinal	28	2,029,526	5,422.50	592,531	63,676,619	1,311,836	.....	12,689,265
Santa Cruz	23	24,801	168.20	223,241	1,192,656	1,078,228	.....	532,487
Yavapai	79	738,221	29,749.08	1,252,894	80,227,549	237,605	1,717,000	17,078,467
Yuma	25	26,129	843.22	7,611	914,499	482,773	.....	221,639
Total								
1919	339	13,727,403	217,997.72	5,266,605	538,100,844	10,203,078	1,717,000	†111,157,872
1918	469	19,038,486	262,919.43	6,686,152	764,855,874	12,503,689	2,269,643	‡202,134,880

*Includes placer production.

†Average value of metals: Gold, $20.6718 per ounce; silver, $1.12 per ounce; copper, 18.6c. per pound; lead, 5.3c. per pound; zinc, 7.3c. per pound.

‡Average value of metals: Gold, $20.6718 per ounce; silver, $1 per ounce; copper, 24.7c. per pound; lead, 7.1c. per pound; zinc, 9.1c. per pound.

A Judge on Experts

On August 27, in an apex suit between the Northport Smelting & Refining Co. and the Lone Pine-Surprise Consolidated Mining Co., involving extra-lateral rights in the Republic mining district, the Federal Court (Judge Rudkin) engaged in a colloquy with counsel, William E. Colby, of San Francisco, on the subject of geological experts. We take the report from the official stenographic record.

MR. COLBY: Our contention is that when a vein crosses a side-line, the burden is immeasurably increased to prove that a faulted vein of this sort turns at an angle and comes across the end-line.

THE COURT: According to your own conception, all this expert testimony is valueless and largely speculative.

MR. COLBY: No, I think we could not get along without it. We could not have had a trial without it.

THE COURT: But it proves nothing substantial.

MR. COLBY: I don't understand Your Honor.

THE COURT: As to where the Black Tail vein begins or ends, or whether it intersects the other line, or stops before it gets there, all of this is a matter of speculation, notwithstanding four days have been spent in taking testimony.

MR. COLBY: In all of these cases there is, we have to admit, a great deal of speculation on both sides, and it is really a case in which speculation is unavoidable. I would be the last person in the world to say that experts were not of value to us.

THE COURT: I did not mean to imply that, but I say, so far as the question of whether or not these veins go on through, or whether they stop at the fault, or so-called fault, it is largely speculative.

MR. COLBY: We have to take the testimony. If we could look into the ground, and have the insight of a prophet, of course, we might tell where these veins were, but the best we can do is to take what the experts tell us and judge from that. They agree on most facts, but when we get into the realm of dispute—

THE COURT: They agree on facts that are not material; but when they are material, they differ.

MR. COLBY: I think there is something to that, and yet I do not think it quite fair to the experts, because I don't think any of these experts would—

THE COURT: I didn't accuse any of them of lying. But I do know that they testify for the man that brings them. They may be brought for that reason, or they may testify that way because they are brought. I don't know what the reason is, but I am discussing only the ultimate facts.

MR. COLBY: They have the liberty of refusing the service, and I believe that these experts here, most of them, would refuse to testify in a case that they did not believe in.

THE COURT: I have no information on that at all.

[In the afternoon of the same day, at the close of Mr. Colby's argument, the Court reverted to the subject, as follows.]

THE COURT: I might say by way of explanation, Mr. Colby, you apparently misunderstood my reference to expert testimony. I had reference exclusively to conditions that existed at the agreed point of intersection between these two veins, and it was entirely a matter of opinion with all the experts as to what transpired at that place. They were in doubt as to whether there was an intersection at all, whether the Black Tail vein even extended to that point; and, of course, if they were in doubt as to that, they must necessarily be in doubt as to whether it extended beyond. I consider the testimony very unsatisfactory on that point on both sides, and I think it is largely a matter of opinion. The experts in this case were extremely candid and very truthful, so far as it related to the physical facts. I never saw less conflict in a case in my life. I will say that much in their behalf.

MR. COLBY: I am very glad to hear that, because I may say that all the experts on both sides felt very sorry to hear Your Honor's comments, because they took them as a personal matter.

THE COURT: Well, it was not personal at all. I had reference solely to the point you were discussing. You were expressing a doubt as to whether the Black Tail ever reached that point or not, and I think the testimony will substantiate that doubt; and then I said that their opinion as to whether it went beyond there was a mere matter of speculation.

MR. COLBY: I appreciate that, as I feel that they interpreted Your Honor's actions as an endeavor to point out to them—

THE COURT: Well, if you will recall, you were discussing the question as to whether the Black Tail ever extended up there at all or not.

MR. COLBY: Yes, that is very true.

THE COURT: And that is entirely in conflict with the idea that it extends beyond.

MR. COLBY: That is true, I agree to that. That is, we are in a state of uncertainty there because there is some vein that extends up. It has some of the characteristics of the Black Tail; it is in a location somewhat near where we would expect to find the Black Tail. The Black Tail goes on in another direction, we don't know where, and it has not been disclosed.

THE COURT: Yes, I realize that.

MR. COLBY: I feel that in such cases as this experts are the only means by which we can understand a situation of that sort. Your Honor can appreciate that if you and I and other counsel should go in there and try to determine what occurred there, we would be at sea. And while the common miner is given high praise, and justly so, in many cases, of course, they are at variance with the scientific facts; and it is only through the experts that we can reach an understanding of these things. As I pointed out in a series of articles which I wrote, this is a defect that is inherent in the law, in the manner in which we try these cases. When you hire men on opposing sides, who are supposed to go underground and ascertain the truth, and they are employed to find the truth, they

naturally and usually lean toward their employers. They could not do otherwise and remain human beings. And when they get into court they have their conflicts, which come about between all opposing witnesses, or witnesses on opposing sides. And yet they do, with entire fairness, try to be impartial. I would not believe of Mr. Simpkins or Mr. Searls that they would stultify themselves in any way. And so I am very glad to hear Your Honor express that view, because all of us misinterpreted your remarks.

THE COURT: I am very sorry they did, because I had an entirely different thought in view.

MR. COLBY: I was sure that you did, because I remember reading in one of your decisions—I think it was Judge Hawley's—who expressed the very highest regard for experts (after practically a life of litigation) that had been called before him in mining litigation. He was referring to mining experts, and he said according to his lifetime experience he had never met with men whom he felt were more zealous to get at the truth, knowing of course that they were handicapped by being employed on opposing sides, but he never, with one or two exceptions, knew of that class of men who would knowingly and wilfully tell an untruth in his court-room. And I felt Your Honor had the same belief.

THE COURT: Certainly.

Geologists as Expert Witnesses

By F. L. RANSOME

*The fundamental difficulty as regards the present system of taking expert testimony appears to lie in the antithetical relation that exists between the scientific and the legal attitude of mind. The life of a scientific man is or should be devoted to the search for truth and, what is just as important, to the promulgation of truth. He should subject all evidence to the most critical and impartial scrutiny and be constantly on his guard against becoming an advocate, even for his own conclusions. Tradition and precedent have no weight with him, and authority, although entitled to respect when founded on observance and mastery of the principles of scientific method, does not bind him. The lawyer, on the other hand, while his intellectual integrity may be unimpeachable and while he may employ the methods of science in certain branches of his profession, is, in ordinary practice, an advocate. It is his business to win the case for his client and his efforts toward that end consist largely in a search for precedent in the form of prior decisions. He is confessedly and properly a partisan and searches for those facts that will help his case. He may also seek for those facts that are opposed to his client's contention, not, like the scientific man, to make them known, but to arm himself against their possible introduction as evidence by opposing counsel. In other words, he may earnestly seek the truth but it is not necessarily his purpose to speak the truth, the whole truth, and nothing but the truth. His endeavors in every way possible to create an atmosphere favorable to the contention of his client and to play upon the feelings as well as the reason of the jury. These two attitudes of mind are so diametrically opposed that it is rather remarkable that practising lawyers, when raised to the bench, should be able to adjust their mental processes to the judicial attitude.

In view of the fact that many eminent and honorable men of science have accepted positions as expert witnesses, it is not justifiable to assert roundly and without qualification that such acceptance was morally wrong. Certainly the intent of wrong-doing has usually been absent and many such witnesses may have been thoroughly convinced of the inherent righteousness of the cause espoused. Nevertheless, I believe that it must be admitted that the geologist who becomes an expert witness for one side in mining litigation places himself in a scientifically false position.

Recently, in an interesting paper, Augustus Locke has suggested† that mining geologists so-called, might be divided into two professional groups—'court geologists' and 'ore-hunting geologists'. He points out that the mental qualifications for the two branches of the profession are not the same—that the court geologist must have the mind of an advocate, whereas the ore-hunting geologist should have the judicial temperament. He cites the Elm Orlu v. Butte & Superior lawsuit of 1915, in which five eminent geologists on one side were unanimous against five equally eminent and unanimous geologists on the other side, both as to matters of fact and to inference or opinion. He puts the case as favorably as possible for the expert witnesses when he maintains that this unanimity in difference, so little creditable to science, involves no personal dishonesty. He explains it by unconscious prejudice.

Perhaps there was no dishonesty in the ordinary moral sense: perjury is a harsh word. But if it be considered that the difference sprang from unconscious prejudice, is there not a more subtle intellectual honesty that is violated when a scientific man, with the example of this and other cases before him, permits himself to be placed in a position wherein he knows he may have to be consciously dishonest or is at best likely to interpret facts through the spectacles of prejudice? It is admitted that such work is not only profitable but is often intensely interesting, and may give opportunity for scientific observations of value. The temptation to engage in it may be very strong. Can a man who cherishes the highest ideals of scientific work afford to yield to it, under the existing practice of employing expert witnesses? Opinions on this question will differ, but my own belief is that in general he cannot. It has been said that a witness before he undertakes a case may be sure of his ground. As a rule no geologist can tell in advance what all the developments in a suit will be, and it is doubtful whether a geological expert witness can escape being a partisan witness when he is employed by one of the litigants with the obvious intent that he shall help to win the case.

*Abstracted from 'Economic Geology', of June 1920.

†'M. & S. P.', January 31, 1920.

Interviews With Governors of Zacatecas and Durango

By Our Representative, Alberto Terrones Benitez

I. Interview with the Governor of Zacatecas, Dr. Donato Moreno

What is your idea of the State of Zacatecas in the way of mining?

Zacatecas is one of the richest mining States in the Republic, developed for years only in its northern part, and operations were carried to a maximum scale at a time when old treatment processes were still in use; the low silver price made possible the extraction of only high-grade ores, and as these were not found in depth, operations had to be shut-down. Lack of transportation facilities and high freight-rates also contributed to the suspension of work in the mines; but now that mining and treatment processes have evolved to a great extent, some plans have been outlined for the resumption of operations in properties where an enormous tonnage of low-grade ores is found; under this scheme the old dumps could be worked and treated. Following this general plan, operations have been already started at Fresnillo, Ojocaliente, Zacatecas, Sombrerete, Pinos, Nieves, and Mazapil. Zacatecas will thus become one of the first mining States in the Republic, as its resources are unlimited.

What steps are you disposed to take in order to encourage mining operations in the State?

First, I will grant the mining companies the maximum facilities falling within the jurisdiction of the State, and at the same time I will take up with the Federal government all matters bringing a benefit to the mining industry; this would be easy to accomplish in view of the political solidarity already existing between the States and the Federal government. Furthermore, I am discussing right now with the Geological Institute of Mexico City and with the Department of Industry and Commerce, the creation of a permanent Geological Survey Commission in the State, which will supply both the mining companies already operating and the prospective mining investors with important information at no cost; this Commission shall start working on the exploration of southern Zacatecas.

Are all the mining companies operating in the State right now?

Few of them are working now, but they are all of importance; the reason is that the country has just gone into a period of peace so indispensable for the prosperity of the Republic. I can see that some well-known mining investors in the State are feeling enthusiastic about the situation, and this government has reason to hope that within a year mining operations will reach their maximum activity.

What will be the policy of the State government in regard to taxes on mineral extraction?

This government, not only in regard to taxes on mineral extraction, but also referring to taxation in general, intends to follow a scheme of proportionate rates; in this manner the small and large producers will bear taxes in just proportion to their output, and the exploring outfits would not have to pay any taxes until they enter into a stage of production.

Is the Executive of the State disposed to facilitate the study, location, and construction of mining railroads?

Certainly I will, and furthermore necessary influence will be exercised before the Federal government for such a purpose; something about it is already discussed by the Representatives of Zacatecas in the Congress, who support our project and who are assisted by the attorneys for the State in Mexico City. Both in regard to this matter and to mining operations, this government intends to give a fair assistance to all concerned with a view to securing the general prosperity of the State and nothing else.

What is the program of the Government in order to intensify mining operations, principally in cases where the paralyzation of works is due to internal difficulties of the corporations?

If I understand this question well, I might say that referring to shut-downs caused by troubles between Capital and Labor, this government has just enacted provisions creating the Labor Department with delegations in all the mining districts of the State. This Department will conduct an intense propaganda against the nefarious activity of agitators, and at the same time will harmonize the tendencies of all parties following a program outlined by this government. So far, we have been successful, and I am sure that mining operations will not be hindered by conflicts between Labor and Capital; due to the importance of this matter it has deserved our preferred attention.

Is the State government disposed to use all its influence so that the railroad companies would grant all necessary transportation facilities to the Zacatecas miners?

Yes, and this matter is of such capital importance that it has already been taken up with the President of the Republic. Also the President-elect, Señor Alvaro Obregon, knows about it, and I presume that all effort is being made in order to supply the National railroads with necessary rolling-stock, the lack of which is causing a crisis in the country and has been a decisive factor in the increasing high cost of living.

Would the State government encourage the organization of a Mining Chamber in Zacatecas?

The organization of Chambers, either of Commerce, of Agriculture, or of Mining, is considered by us as of essential significance, provided they accomplish their end, namely, the regulation of production, of imports and exports, the supply of working capital and implements, and even the regulation of minimum salaries in all centres of production.

Would you be disposed to advise the foreign corporations through the 'Mining and Scientific Press' to resume mining operations in Zacatecas at the earliest possible date?

As already stated, this government could not be more liberal, nor could there be any better intention on the part of the Executive of the State, to facilitate all promoting business men the necessary assistance for mining operations, and the 'Mining and Scientific Press' should play an important rôle by initiating a well-intentioned propaganda with a view toward making American miners acquainted with our true situation. Should the 'Mining and Scientific Press' need any more data or statistical information in regard to mining in the State of Zacatecas, I will gladly furnish it upon application.

II. Interview with the Governor of Durango, General Jesus Agustin Castro

What is your idea of the State of Durango in the way of mining?

The mineralized part of the State already under development—not counting the unexplored country—could not be worked out by 500,000 laborers working continuously during 100 years.

When taking possession of your office as Governor of the State, what policy would you follow in order to encourage mining operations?

My policy will be to facilitate the installation of as many smelters in the State as may be necessary for the miners to sell their products under non prohibitive terms.

Have you any special program to carry out in order to intensify mining production in the State?

This question has the same answer as the former.

As the country really lacks national capital to go into the large mining ventures, are you of the opinion of calling on the foreign investors, with the understanding, of course, that all the investments made here shall be subject to the laws of this country?

I believe that an active propaganda should be started in order to evidence the unlimited mineral resources of the State of Durango practically undeveloped up to the present time. My idea is to establish a Statistical Mining Department in the State, to work either alone or in conjunction with the Industry Department of Mexico City; mining and geological explorations will be thus conducted all over the State, the results to be published for the sake of information to all mining investors.

In case of calling on the foreign investor, would you be willing to use the 'Mining and Scientific Press' as a means of communication, so that those already operating in the State would resume work in the mines, and so that prospective investors should take an interest in Durango.

I think it advisable to use the paper mentioned by you as a means of communication to foreign investors, and to this effect I might as well say that the Government of the State of Durango is entirely disposed to grant all necessary protection and facilities for mining exploration and exploitation within the statutory provisions.

Is your program to encourage and support all the projects for the construction of railroads to mining camps?

The Government of the State should never hesitate to co-operate in the reorganization of all railroad schemes already existing or that may be proposed in the future.

What do you intend to do in regard to mining taxes corresponding to the State?

I have no definite plan as regards the tax on mineral extraction; but referring to taxation, in general, my idea is to try better distribution of the burden among the tax-payers, so as to be able to diminish the taxes to a just amount.

Are you disposed to encourage and support the organization of a Mining Chamber in the State?

As I understand that a Mining Chamber would have for its object to promite, safeguard, and harmonize all mining interests, it would thus co-operate with the Government, and, of course, I should support it.

Do you think advisable the establishment of a practical mining schools in the State of Durango?

As Durango is essentially a mining State, I would certainly advocate for the establishment of one technical and several practical mining schools in the State.

Have you decided to use all your influence to facilitate the railroad transportation of machinery, materials, and supplies to the mining districts?

I have decided it, and for such a purpose I have already taken this matter under my care. I have called the attention of the Federal government to the resumption of traffic between the State of Durango and the United States by way of the old International Railroad, thus getting through-communication from here to San Antonio, if necessary, without the long and tiresome detour by Saltillo and Monterrey.

Do you think that conditions in the State are such that no further delay in resuming operations is justified?

All the State of Durango is in perfect condition of safety, and therefore any delay in operating the mines is not justified.

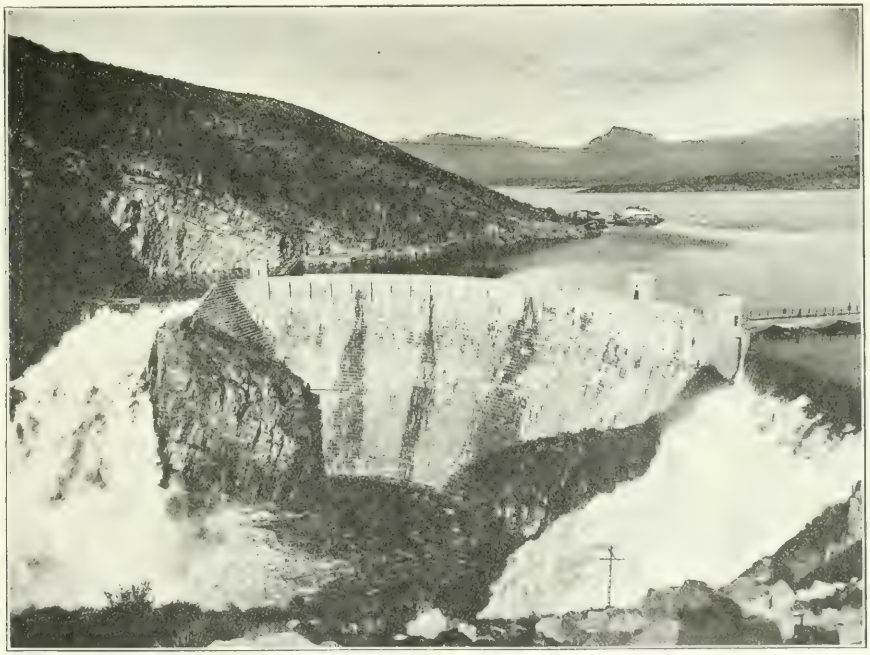
REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

PROPOSED AERO-ROUTE BETWEEN JEROME AND TONOPAH. NEVADA. NEW CONSOLIDATION IN TOMBSTONE DISTRICT.

JEROME.—The aeroplane may become an important factor of transportation between the mining districts of Nevada and Arizona if plans now under consideration are carried out. A test flight will be made between Tonopah, Nevada, and Jerome, Arizona, in an attempt to cover the distance of 320 miles without a stop. Since the discontinuation of the Tonopah & Tidewater railroad, the quickest route by rail is from Tonopah to San Francisco, and from there into Arizona by way of Los Angeles, a trip of at least three days. The journey by air can be accomplished in less than four hours.



THE ROOSEVELT DAM. ON THE ROAD FROM GLOBE TO PHOENIX, ARIZONA

PATAGONIA.—An important find of rich sulphide ore is reported at the Hardshell mine, nine miles from Patagonia, near Harshaw. The new ore was opened by a cross-cut from the main shaft. Shipments have netted $100 per ton from silver-lead ore. It is planned to substitute electric power at the mine in place of the fuel-oil now in use.

TOMBSTONE.—The Mellgren group of 55 claims has been taken over by New York capitalists represented by Bisbee interests. The new company will be known as the Tombstone Silver Fields Co., Inc. The same company has also taken over the Old Guard mine, on the property of which is situated a 10-stamp mill that will be used for the test-mill. The Merrimac group of seven claims is also included in the transaction, and negotiations are under way for the purchase of the Argenta group, thereby taking in practically all of the western end of the Tombstone mining district. The company plans to begin the construction of a 250-ton mill at once. Machinery for the Solstice Mining & Milling Co. has arrived and is being

set up. A compressor, hoist, and accompanying machinery, all new, are included in the equipment, which totals more than $10,000 in value.

JEROME-VERDE.—The newly installed engine and compressor of the Verde Central are in operation, and air-drills have replaced hand-steel in driving the main tunnel. A few days should see the face of the tunnel reach the intersection of the contact, which the tunnel is following, with the main dike that cuts the country.

NOGALES. Three leaders among the Yaqui Indians, Antonio Bacasegua, Jose Matus, and Luis Buitimea, who were at Nogales last week on their return from Magdalena, gave glowing reports of the mineral wealth in the mountainous country which the government of Mexico has given to them. Bacasegua said: "In the Sierra Bacatete, the ancient stronghold of the tribe, where we held out so long, we know of many good mineral deposits that we would like to work; and we know them to be very rich, well worth development and exploitation, with gold in abundance. Some of these mines were worked many years ago, as there are old workings and traces of habitations. We desire to be permitted to prospect and develop those mines; but we need the aid of the Government in supplying the equipment necessary for doing so. If we cannot obtain that assistance we shall turn to American capital for aid."

PHOENIX.—The Arizona Corporation Commission has denied the application of railroads operating in Arizona for permission to raise intra-state freight-rates 25%. It was alleged that costs of operating railroads had advanced in Arizona the same as elsewhere and that intra-state rates should be advanced to conform with the inter-state tariffs. What the immediate result of the commission's refusal will be is not known, but it is believed that the railroads will immediately order the printing of supplementary tariffs, embodying the increases and will apply to the courts for an injunction restraining the corporation commissioners from taking any steps to prevent the advances becoming effective. The advances, if made, will be a severe blow to the mining companies that ship ore to smelters and receive timber from mills in the northern part of the State.

BISBEE. The Junction shaft of the Calumet & Arizona Mining Co. is being sunk 500 ft. from the 1800 to 2300-ft. level. Work has progressed approximately 225 ft., at the rate of about 3½ ft. per day. Two compartments are being sunk to the lower level. The work of concreting the Campbell shaft of the Calumet & Arizona Mining Co. is progressing satisfactorily, and is completed from the 687-ft. level up to about the 550. The work was started from a depth of 687 ft. and it is expected that it will be completed from that point to the collar of the shaft about November 10. The shaft was originally sunk 562 ft., then raised from the 1300-ft. level and holed-through. It was then stripped to three-compartment size, to a depth of 687 ft., and concreting was started. When this section is completed, the lower part of the shaft will be stripped and concreted. The area of the completed shaft will be 170 sq. ft. Eventually this shaft will in all probability become the main hoisting shaft of the company and should thereby reduce the cost of production.

GLOBE.—News has been received that a suit for $500,000 for the foreclosure of a lien against the Inspiration-Miami Copper Co. has been filed in the Superior Court by attorneys representing Jacob Kleinfelder and associates. It is alleged that Kleinfelder and his associates pooled their holdings in order that the company might be formed, and that the company agreed to do a certain amount of development work, and pay them $400,000. Plaintiffs claim that these contracts have not been fulfilled and they are therefore suing for the amount involved.

COLORADO

ACTIVITY AT CRIPPLE CREEK IS REVIVING.—BELL MINE NEAR MONTEZUMA IS OPTIONED.

CRIPPLE CREEK.—Two shifts are again employed at the Portland mine, the return of old miners and influx of new men having made the increased force possible. The production at the Portland has already shown an increase and the Battle Mountain property and Cresson mine are now the heaviest shippers of the district with the Modoc third. Development by the Dig Gold Co. on the Caledonia spur of Gold hill at the 375-ft. level is reported to have opened a strong vein of low-grade ore which is improving as the drift nears the Gold Bond vein-system. Sinking is under way at the Forest Queen mine, owned by California and Colorado people, and operated under lease by the Forest Queen Mines Co.

GEORGETOWN.—A tramway from the Snowdrift mine to the Hudson mill at Idaho Springs has been completed and shipments of low-grade dump-ore have commenced. The Silver Plume Consolidated Mining Co., operating this property, is also doing work on the Buxton mine on Hanna mountain. The Dives-Pelican dumps have been sampled and a test-run is in progress at the Wasatch-Colorado mill.

LEADVILLE.—Machinery and supplies have been hauled to the property of the Gold Leaf Mining Co. in the Tennessee Park section, where deep development is planned. A camp has been established and work will continue through the winter months. The property to be developed adjoins the Jenny June and Louis L. mines. A 'home' mining company is proposed for Leadville and a referendum will be taken by the Chamber of Commerce as to the advisability of the plan.

MONTEZUMA.—An option on the Bell mine in this district has been given to G. H. Short, a mining engineer of Salt Lake City, representing Utah operators. The Bell has been inactive for more than twenty years, but is reputed to have produced high-grade lead-silver ore. Mine records are said to show shipments of 16 cars averaging 116 oz. silver and 37% lead. A shipment of sacked ore, not figured in the average, yielded 8000 oz. of silver per ton. Mr. Short is said to have measured a good tonnage of ore blocked out with the value estimated at $90 per ton in addition to low-grade milling ore.

ROSITA.—Ore assaying around 100 oz. silver per ton

has been opened up at a depth of 25 ft. on the Humboldt-Pocahontas vein by owners of the Stevens and West Leviathan group. Machinery will be installed. Ore assaying 75 to 100 oz. silver per ton has also been opened on the Annie recently purchased by the Fowler M. & D. Co. The Brittle Silver, an old producer, is under bond and lease to J. B. Putman, a Rosita merchant and mine-operator.

OURAY.—If weather conditions permit a power-line will be extended to the Mickey Breen property in Poughkeepsie gulch by the Loyal Mining & Milling Co., which is operating the property. A new milling-plant will be constructed next spring. The Gem City Mining & Milling Co. will continue development during the winter of its Wehawken property comprising 14 claims. A camp has been established and buildings erected for the miners. Ore outcropping at surface is reported to assay $16 to $50 per ton in gold, with some silver.

WESTCLIFFE.—The Plaza Flora Mining Co., operating on Bend Wert hill in the Wet Mountain Valley district, one mile north-west of Westcliffe, reports finding high-grade copper ore in its 50-ft. shaft. Samples assayed from 7 to 30% copper.

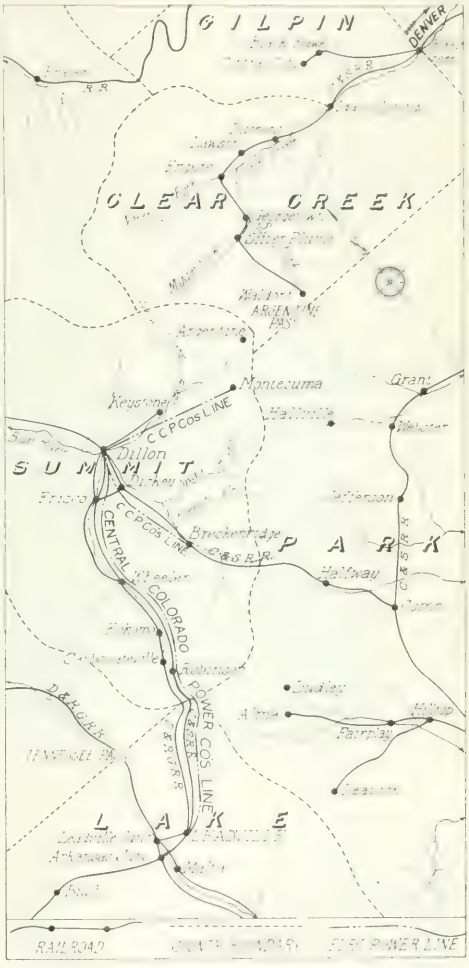
MICHIGAN

STOPE-SCRAPERS ARE BEING BUILT BY CALUMET & HECLA.—DEVELOPMENT WORK MAY BE RESUMED BY FRANKLIN.

CALUMET.—The importation of scrap-copper from abroad is seriously affecting sales of Lake copper and unless there is an unexpected turn for the better, the lull in the market is expected to continue for some time. Shipments for October have been unusually light, and there have been no outgoing cargoes of any consequence. The result is that copper is piling up and, with the exception of Calumet & Hecla, practically all producers are carrying larger surpluses than at the first of the year. Calumet's supply is estimated at more than 22,250,000 lb., including 13,000,000 on the docks of the old Union Smelting plant. The Stanton mines—Mohawk and Wolverine—are among the few that are caught up on production and these properties would produce more copper if men were available. The Copper Range mines have about the same amount of metal on hand as six months ago, while Quincy makes only occasional shipments.

According to present indications the mines will not suffer from a shortage of labor this winter, for large groups of former employees are returning from the automobile factories. The Calumet & Hecla mines are gaining about 25 men per week, with the majority of the new employees being given places in the conglomerate department. Isle Royale is well supplied with labor, maintaining a force sufficient to keep its own milling plant operating to capacity, and Ahmeek's force is as large as conditions warrant. Notwithstanding the fact that production is barely more than 50% of normal, there is no unemployment in the Lake region. Some of the smaller mines are idle, but whenever an underground man seeks a job he has no difficulty in finding one. It required years to build up organizations to the standard of efficiency that ruled in the Lake district and every effort is being made to keep the forces as nearly intact as possible.

Calumet & Hecla has begun to make stope-scrapers in its shops and by spring it will have a fairly large supply for use in its own shafts. The subsidiaries in all likelihood will be supplied as soon as possible, but it may take more than a year before the scrapers are in general use.



MAP OF CENTRAL COLORADO

A scraper, operated by two men, can perform the same work that six to eight do by hand in the same length of time. Not only will this device help to reduce costs, but it no longer will be necessary to seek trammers as in the past, once the scrapers are available in sufficient numbers. Tramming is the hardest work in a mine and the introduction of these machines will do away with much of the drudgery. When labor has been scarce the first department to suffer has been tramming and a shortage in this particular immediately affects production.

Calumet & Hecla's haulage-level is proceeding southward slowly, with the drift breasted about 1000 ft. south of the Hecla No. 7 shaft. The terminal still is close to 2000 ft. distant, so it probably will be the end of 1921 before the project is complete. The tunnel is 12 ft. wide and at the end of each 700-ft. section drilling is stopped to permit the application of a coat of gunite on the walls and top. The haulage-way will connect all of the Calumet & Helca and Tamarack conglomerate shafts. It is 8100 ft. from the surface and will be 1½ miles long. No. 12 shaft, C. & H. will be the supply and pumping-shaft, while the Red Jacket will be used for hoisting. All of the surface equipment of the other shafts will be dispensed with, once the new haulage-way is in operation. The project will require the construction of a sump with a capacity of 3,000,000 gal. and the installation of more powerful pumps. To operate these pumps two large high-pressure steam turbines will be installed at the mills, increasing the capacity of the power-plant to a point where it can meet any emergency.

An announcement is expected shortly as to the future course of Franklin. The company may determine to resume development at once so that it will be able to produce on a quantity basis more quickly than if additional opening work was deferred. Franklin's first operations, when production is resumed, doubtless will be on the 39th level, north, where splendid disclosures were made on the Pewabic lode. For a distance of 600 ft. ground that should yield 25 lb., refined, has been proved and it is believed that the same mineralization will extend up to the 30th level. Since development work ceased some months ago only the pumps have run.

The Copper Range mines report a slight decrease in output during the past month, but the yield holds up well, with Champion averaging 45 lb., refined, Baltic varying from 30 to 35, and Trimountain, 27. Mass enters into this, however, particularly at Champion, though the shipments of native copper are not as large as when the mine was operating at the peak. Development work at Champion practically has stopped and few new openings are being made at Baltic. On the other hand, Trimountain is in the midst of extensive development of the bottom of the mine.

There is a likelihood that one of the first tests with flotation on amygdaloid 'rock' will be made by the Copper Range company. If an additional pound of copper per ton can be recovered by means of this process it will increase the output, based on the average production for 10 years, by 1,000,000 lb. per year. If Copper Range can successfully and profitably apply flotation, Mohawk likewise could increase its yield, though the latter plans to direct its first efforts toward reducing losses by finer grinding.

NEVADA

NEVADA SECTION OF A. I. M. & M. E. MEETS AT TONOPAH — LESSEES AT PIOCHE DISCONTINUE ON ACCOUNT OF FREIGHT RATES.

Divide.—The cross-cuts on the 800 and 1000 ft. levels of the Tonopah Divide have entered the vein and drifting has been started. That on the 800-ft. level entered the vein at 180 ft. from the shaft and that on the 1000 entered it at 200 ft. from the shaft, the latter having been driven farther south-east. The Victory has cut the vein at 500 ft. and ore assaying $35 to $40 for a width of 6 ft., the width of the vein, has been found. A drift is now being driven. The vein was entered 110 ft. from the winze from the 200-ft. level. The south-east drift on the 400-ft. level of the East Divide, being driven in a vein 30 to 40 ft. wide, continues to expose narrow seams of ore. The vein is narrowing, giving the management hope that a good width of ore that can be shipped will be found. This drift is being driven toward the extension of the vein recently found in the Gold Zone and the so-called Julian vein of the Tonopah Divide. Ore 3½ ft. wide and assaying $15 to $20 has been found in the south-east drift on the 400-ft. level of the Alto. This drift also is being driven toward the extension of the veins striking into the Alto from the Gold Zone and Tonopah Divide. The Kernick, at a depth of 900 ft., has started work to prospect a large territory in the western part of the district, including the Hasbrouck, Western, Revert, and Annex. The Brougher is sinking from the 500-ft. level a winze that, at 1000 ft., will be connected with the Tonopah Divide workings. The Gold Zone has started shipping from the vein found recently on the 700-ft. level and it is estimated that 1000 tons is available. The shoot is 45 ft. long. It is the frequently expressed opinion of engineers in charge of work in nearby ground that the Zone will have to sink farther before the best results can be obtained near the Tonopah Divide line.

Tolicha.—It is reported that the deal for the sale of the Landmark group has fallen through, the holders of the option having relinquished it for an unknown reason. W. J. Loring has denied that he is connected with any deal involving the claims.

Leadville.—The 50-ton concentrator of the Leadville Mines Co. has been started and it is expected that within two weeks it will be operating at capacity. There is estimated to be blocked out in the mine 5000 tons of ore containing 30 oz. silver and 5% lead. The earning capacity over all mine and mill expense will be $10,000 monthly, according to A. A. Codd, general manager, who says the production of the plant will be 150 tons of $200 material monthly. The vein, 3 to 4 ft. wide, is in a fissure in limestone. The mine is worked through a 1500-ft. tunnel, from which a 300-ft. winze has been sunk. Most of the ore is in workings from the bottom of the winze, 500 ft. from the surface. The Grandma shaft is now 870 ft. deep. Since sinking was resumed it has passed through a tongue of alaskite, then shale, and it is now in alaskite, a reversal of the order in which these formations are usually found in the district. The flow of water is heavy and this has retarded sinking.

Virginia City.—During the last week 67 tons of ore of a gross value of $35,000 was mined in the drift from the bonanza winze from the 2150-ft. level of the Consolidated Virginia. This drift is 80 ft. long. The east

drift on the 2250-ft. level has been re-opened and a raise is to be driven from it to the winze from the 2150. Ore also is being broken on the 1950 and 2050-ft. levels. During the week 341 tons of ore of a gross value of $15,000 was treated at the Mexican mill.

TONOPAH.—The annual meeting of the Nevada section of the American Institute of Mining and Metallurgical Engineers was held in Tonopah on October 26 and 27, with 40 present. The following officers were elected: John G. Kirchen of Tonopah, chairman; J. C. Jones, professor of geology, University of Nevada, vice-chairman; H. M. Rives of Reno, secretary-treasurer. The executive committee is composed of John G. Kirchen, J. C. Jones, R. A. Hardy, Virginia City; W. S. Larsh, Ruth; F. Dean Bradley, Goldfield; Governor Emmet D. Boyle; J. L. Dynan, Tonopah; Alex Wise, Virginia City; W. H. Blackburn, Tonopah. The following papers were read: 'Surface Plant at Victor Shaft, Tonopah Extension Mine', J. P. Hart; 'Operating Conditions at Tonopah Extension', John L. Dynan; 'Mine Pumping in Tonopah District', Homer L. Willams; 'Crushing and Agitating Practice at Tonopah Extension Mill', H. A. Burk; 'Precipitation and Refining of Gold Concentrates at West End Mill', Fred Ninnis and Walter Anderson; 'Tonopah Extension Assay Office', George L. Christian; 'Mine Accounting', F. Dean Bradley.

PIOCHE.—A number of lessees in this vicinity have ceased operations, as a result of the increase in freight-rates on ore-shipments and incoming supplies. It is estimated that the operators here paid an additional $7000 during September by reason of the higher rates on ore shipments to Salt Lake valley smelters. Ore having a value of $20 per ton now takes a rate of $7, as compared with the former rate of $4.50 per ton. This is a heavy burden on the industry, particularly in view of the declining market for the metals produced. During the week ending October 23, the Prince Consolidated shipped 1925 tons; Virginia-Louise, 505; Combined Metals, 150; Bristol Silver Mines, 90; Columbia Trust, 40; making a grand total of 2710 tons. Negotiations are pending for the sale of the Silver King mine, 38 miles north-west of here, by Vernon Jeffcott and C. M. West of Pioche. The property comprises four claims, and in 1902 some bonanza silver ore was found. Several tons of ore running as high as 10,000 oz. per ton was shipped, which resulted in a rush to the district, the ground being staked for miles around. It is stated that 400 tons of material has been sorted from the old dumps, which averages 11.5 oz. silver and 4.3% lead. In the early days, when the property was 150 miles from a railway, a 50-ton smelter was built. The Salt Lake Route now passes within 23 miles of the property and there is a good road connecting the mine with Jackrabbit station.

GLORY-HOLE AT COMBINATION SHAFT, GOLDFIELD, NEVADA

UTAH

SMELTING COMPANIES ARE SUED BY RAILROADS.—REGULAR SHIPMENTS ARE BEING MADE FROM AMERICAN FORK CANYON.

SALT LAKE CITY.—The University of Utah will give extension-courses in mining, milling, smelting, and Americanization in the various mining districts of the

State, according to F. W. Reynolds, in charge of the extension division. The mining and metallurgical courses will be under the direction of Robert S. Lewis, professor of mining, while the Americanization work will be under the supervision of A. M. Thurman. During the week ending October 23, the Utah Ore Sampling Co. at Murray released 68 cars of ore from Utah mines; 8 from Nevada; 5 from California; and 2 from Idaho. At the Tintic plant of the company, 34 cars from Utah mines were released. The Oregon Short Line Railroad Co., acting on behalf of itself, the Denver & Rio Grande, and Los Angeles & Salt Lake railroads filed suit on October 26 in the U. S. District Court against the American Smelting & Refining Co., seeking to collect $23,830, with interest from date of filing. The money is alleged to be due to the railroad companies for the building of a switching system at the Murray plant of the company, seven miles south of this city, and for the handling of railway cars used in making shipments. The Denver & Rio Grande and Los Angeles & Salt Lake companies participated in the expense, and conveyed their claims to the Oregon Short Line for collection. On October 28 the same companies also filed suit against the United States Smelting Co., for $23,006, alleged to be due for switching performed at the Midvale smleter of the company from November 1916 to December 31, 1917.

Ophir.—At the property of the Ophir Silver Mines Co. the adit is now in a distance of 110 ft., and it is expected that within an additional 50 ft. the Buckhorn vein, said to be the productive lode in the Ophir Hill Consolidated mine, will be cut. Drifting to the north and south will follow. At about 200 ft. south a promising east-west vein, developed near the surface by an inclined shaft, should be cut. In this tunnel three feet of ore was opened containing 2 to 4% copper and from 50 to 100 oz. silver per ton. This vein had to be abandoned in the upper workings because of caving ground.

American Fork.—An examination of the Pittsburgh mine in American Fork canyon has recently been made, and it is reported that the property will be taken over by Eastern interests. The mine is owned by the Alexander T. Tarbett estate of Salt Lake City. In 1916 Mr. Tarbett was actively engaged in deep development of the property, which is situated on the divide between American Fork and Little Cottonwood canyons. In the early days, the mine was one of the largest producers of silver-lead ore in this district. It is stated that there is about 16,000 tons of milling ore in sight. Two mines in the canyon are making regular shipments. The Silver Dipper property, under lease to George Hemphill and associates, is making steady shipments of silver-lead ore. Shipments of sulphide ore containing lead-silver-gold are being made by the Belorophan property, of which Carl Ferlin is manager. The Globe Consolidated property has been closed for the winter, according to John Cleghorn, president. Shipping ore has been found in several places, and if it were not for the lateness of the season, shipments could be made. There is more than a foot of snow, which is unusual for October.

Park City.—Exploration of the O'Brien vein-system by the Silver King Coalition and Three Kings Consolidated Mining companies is giving important disclosures. Work already done in the Coalition property proves that the O'Brien chanel is a third large ore-zone in the district, and engineers predict that it will equal the Silver King zone as a producer of rich ore. The O'Brien system is a series of fissures and faults which strike northeast approximately 1200 ft. north-west of the Silver King zone. The Park City limestone, which is regarded as the formation in which the best bedded ore deposits have been found, is traversed by the system of fractures. The fractured zone is about 800 ft. wide. In the Three Kings property, a cross-cut was driven from the shaft a distance of 1000 ft. to the south-east, on the 500-ft. level, to cut the strata that dip north-west. A zone of intense fracturing was developed by this work. Some of the ore assays 100 oz. silver and 60% lead. The Three Kings property owns 156 acres of patented ground and is believed to have several thousand feet on the strike of the O'Brien channel.

Conditions at the Naildriver mine are promising, according to J. D. Fisher, superintendent. Recently a vein was cut on the 500-ft. level, which is thought to be a continuation of the orebody opened on the 700 and 900-ft. levels. Steady shipments are now being made. During the week ending October 23, the Silver King Coalition Mines shipped 646 tons of ore; Ontario, 497; Judge, 289; Daly-West, 168; Naildriver, 60; Keystone, 55; and New Quincy, 3; making a total of 1718 tons. The machinery for the new milling plant at the Glenallen property is being placed, according to J. B. Allen, manager. Inasmuch as it has to be hauled from Heber over poor roads, there has been more or less delay, but it is expected that the plant will be ready for operation by the first of the year. It is stated that there is a large tonnage of milling ore developed in the mine merely waiting the completion of the mill.

Eureka.—Shipments of ore from this district during the week ending October 23 totaled 169 cars, an increase of 46 cars over the previous week's shipments. The Chief Consolidated shipped 41 cars; Tintic Standard, 34; Mammoth, 23; Dragon, 15; Iron Blossom, 12; Eagle & Blue Bell, 8; Centennial-Eureka, 6; Iron King, 6; Grand Central, 6; Victoria, 4; Swansea, 4; Bullion-Beck, 3; Gemini, 3; Gold Chain, 2; Eureka Hill and Yankee, each 1. A contract has been signed between the Dragon Consolidated Mining Co. and the United States Smelting Co., whereby the former will ship about 100 tons of iron ore per day to the Midvale plant of the smelting company. The north end of the Dragon property is under lease to the Tintic Milling Co. and approximately 50 tons per day of mill grade ore is being extracted. The Tintic Delaware Mining Co. has filed an amendment with the county clerk of Utah, seeking permission to make the capital assessable. For some time past, this property has been idle, but recently a decision was reached to resume operations and for this purpose it is necessary to levy an assessment.

BRITISH COLUMBIA

PRODUCTION AT COPPER MOUNTAIN COMMENCES.

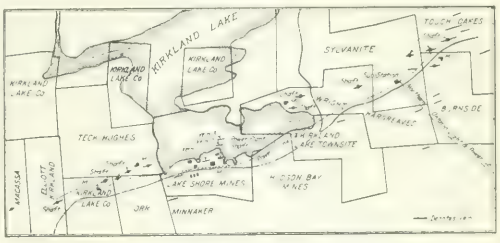
PRINCETON.—After a long series of delays, the Canada Copper Corporation started actual mining operations at its Copper Mountain property on October 19, and on that day the first trainload of ore went to the mill, at Allenby, four miles away. Numerous strikes have delayed operations at mine, mill, and railway; and other difficulties have appeared. The undertaking represents an investment of $7,000,000, which, owing to the many delays and the rise in cost of labor and supplies is $500,000 more than the original estimate. At the present time the company has 300 men on the payroll, this number to be increased gradually to 500. Before the end of the year it is hoped to bring the output of the mine up to 2000 tons per day which is the present capacity of the mill. The company has developed 12,000,000 tons of ore, and this, it is believed, can be mined and milled at a low figure. The concentrate will be sintered and smelted at Trail. Edwin T. Hodge, general manager for the Liberator Mining Co., which owns the Emancipation mine, near Hope, states that the development tunnel is being driven at the rate of 10 ft. per day and that the upper tunnel has penetrated five ore-shoots and has entered the sixth. During the last two months a compressor and a power-plant have been erected and an assay-office has been built. A quantity of mill-ore has been taken out during the course of development.

ANYOX.—The Granby Consolidated M. S. & P. Co. produced 2,239,174 lb. of copper during September, against 2,439,200 lb. in August. The company made a net profit of $443,586 during the first half of the present year; from this, however, taxes and interest on bond issue have not been deducted. The profit for the last half of last year was $599,386, and taxes and interest amounted to $539,487, leaving only $49,899. The smelter town expressed its wishes emphatically at the plebiscite, on October 20, giving a vote of practically 10 to 1 against prohibition.

PRINCE RUPERT.—The net earnings of the Belmont-Surf Inlet Mines, Ltd., a subsidiary of the Tonopah-Belmont Development Co., for the quarter ended June 30, 1920, amounted to $77,535. Last year this company did 5550 ft. of development, and this year it has kept development work well ahead. The company produces a high-grade gold-silver-copper concentrate, which is shipped to the Tacoma smelter.

STEWART.—S. G. Benson, an operator in the Portland Canal district, refers optimistically to the Blue Bird and Nest Egg claims on the Salmon river. Several veins have been uncovered from which samples have been taken that give good assays. Mr. Benson and his partner have been prospecting this particular country for years, but it was not until last year that they found anything worth while, due to the fact that a glacier, which has been receding about 200 ft. each year, formerly covered the outcrops. It is the intention to begin tunneling next season. On the Lucky Boy group in the same locality a vein has been found about 60 ft. wide, the average value of the ore being estimated at $100 per ton. It is stated that the galena from this property is the cleanest seen in the country so far, there being no zinc. Considerable development has been done but next year permanent camps will be established. This property is situated between the Premier mine and the town of Stewart. Much is expected, too, of the New York group. The results of recent work is reported to have been satisfactory. Owners of the White Mouse, also, are understood to be planning the erection of a mine plant.

ALICE ARM.—The Esperanza group of mineral claims has been taken over by a syndicate of Vancouver businessmen. The consideration is said to have been $75,000 which nets the owner, Petro Salina, a comfortable profit which will be appreciated when it is stated that he acquired the property some years ago at a sheriff's sale for $200. Recent development work has been encouraging,



KIRKLAND LAKE DISTRICT, ONTARIO

with a considerable body of high-grade silver ore uncovered.

PRINCE GEORGE.—There is a possibility that one or more of the same type of giant gold-dredges that have been operating in the State of California will be constructed for digging the gold-bearing gravels of the Fraser river and of the creeks and gulches of the Cariboo district. A party of operators from the United States, one of whom represents the Yuba Manufacturing Co., of Marysville, California, has been visiting Prince George for the purpose of investigating conditions and forming an estimate of the prospects of success attending the venture. Years ago, as an aftermath of the Cariboo gold excitement, several small dredges were built on the Fraser river and elsewhere. The remains of these still may be seen in the river and on the banks just below the town of Quesnelle. There is a dredge on the Quesnelle river and one was taken up-stream beyond Fort George to the Little Smoky river, where it lies a derelict today.

VICTORIA.—With reference to the policy of the Provincial government of assisting in the exploration and development of such mining properties as seem to merit the expenditure, where the owners are unable to do their own financing, William Sloan, Minister of Mines, has made an interesting statement concerning the past year's work. He says that diamond-drilling and other development has been in progress for some months on the Snowstorm group in the Highland valley and that drilling has been undertaken by the Government in the Franklin camp, the results in both cases being satisfactory. R. W.

Thomson, engineer, who is in charge at the Snowstorm, says that it is expected that it will take another year to complete the work in hand. A large amount of ore has already been developed. The minister says in conclusion: "On work of this character the Government has a bonus-charge against the property equal to the cost of the work, that is to say, for every dollar spent in development the property will owe the Government two dollars. Although it is not expected that all diamond-drilling operations will prove remunerative, the policy of the department is to place this drilling and development of mineral claims, as far as possible, on a profitable basis."

ONTARIO

FLAT WAGE OF $5.25 ANNOUNCED BY TEMISKAMING MINE OPERATORS.—MORE MINERS REQUIRED AT PORCUPINE.

COBALT.—The Temiskaming Mine Managers' Association has notified the Central Council of workmen in the silver mines in the district that after November 1 a flat wage will be paid instead of the former base wage plus a bonus determined by the price of silver. Formerly machine-runners were paid $4 daily, when silver was under 80c. per ounce, with a bonus of 25c. when the price was 80c. and an additional 25c. for each ten points above 80c. per ounce. Accordingly the bonus amounted to $1.50 per day when the price of silver rose to over $1.30 early this year. On the other hand, when the decline in quotations carried the price down, the companies announced that they would continue the bonus of $1.25 until November 1. The schedule now announced gives to machine-runners a flat wage of $5.25 per day, the highest ever paid in Cobalt. Low water on the Montreal river has caused a serious shortage of power, causing the mines to curtail operations to some extent. Arrangements have been made to work certain of the mines alternately pending rainfall. On November 1 the Coniagas will disburse a dividend of 2½%, amounting to $100,000. This makes a total of $500,000 paid this year, and a grand total to date from this company of $10,040,000.

The Keeley Mines in South Lorrain has completed the erection of a 20-stamp mill. The plant is being tried out this week. The equipment was purchased early last spring from the Coniagas Mines, this being a part of the machinery on the Trethewey mine the property and plant of which was purchased for $100,000 by the Coniagas early this year. The development work on the Keeley has been favorable during recent months. A shipment of 11 tons of high-grade ore has been made from the Castle property at Gowganda. The brokerage firm of F. C. Sutherland & Co., of Toronto, has acquired an option on the tailing from the Penn-Canadian mill and hopes to make arrangements for the recovery of the contained metal.

At the Lumsden property of the Camburn Mining Co. the Croft vein has been opened up more than 50 ft. with high-grade silver veins appearing at intervals. A winze is being put down on the Horseshoe vein from the 300-ft. level to the diabase-Keewatin contact estimated to be 175 ft. below. Several other properties are being prospected in the vicinity of the Lumsden, all of which are sinking to reach the contact, influenced by the success of the Beaver and Temiskaming at that depth.

PORCUPINE.—The need for additional mine workers at this camp is receiving the attention of the Provincial government. H. C. Hudson, general superintendent of the Employment Service branch, has made an official visit to the mining districts of Northern Ontario. The labor requirements of Porcupine, Kirkland Lake, and Cobalt are estimated at 2000 men. By far the most serious shortage is at Porcupine, where the Hollinger Consolidated is prepared to take on 800 additional men, while the Dome, McIntyre, Porcupine Crown, and Vipond-North Thompson are anxious to increase their working forces. The Dome is endeavoring to secure labor from England. Mine operators are hopeful now that the urgency of the situation has been made the subject of an official enquiry that the Ontario government may take some action for their relief.

KIRKLAND LAKE.—The Kirkland Lake Proprietary, Ltd., has completed the taking over of the assets of the English Tough Oakes, the old Kirkland Lake company, the English Aladdin-Cobalt, and the Sudbury Syndicate. The new company is also arranging to acquire the assets of the Ontario-Tough Oakes Gold Mines, the Burnside, and the Sylvanite.

GOWGANDA.—A vein intersected in a cross-cut at the 85-ft. level of the Castle property of the Trethewey shows a width of six inches of high-grade silver ore, and wall-rock heavily impregnated with silver. Another important find has been made at the Miller Lake-O'Brien, the vein several inches in width, carrying heavy leaf silver. A narrow vein of this character of ore can be worked with a good margin of profit.

TORONTO.—Reports were recently received by the Imperial Oil Co. of an important strike in the well at Fort Norman on the Mackenzie river, near the Arctic circle, where the flow was stated to be at the rate of from 1000 to 1500 barrels per day. C. O. Stillman, president of the Imperial company, states that he has received confirmation of the news. The 'strike' was made August 25 at a depth of 783 ft., oil flowing out of the 6-in. pipe for 30 minutes before the well was capped. Any estimate, however, as to the amount of oil this well could produce is only a guess as there was no tankage available, and an accurate test could not be made. While he considered it of scientific value, from a comercial point of view it is not of immediate value, as it would probably be years before it could be made available in quantities for the use of the Canadian market on account of its remoteness. The well is situated 45 miles below Fort Norman, 900 miles from the nearest sailing point of a river boat, 1200 miles from the nearest railroad, and 1500 miles north of Edmonton, the nearest city by the present route. The only means of access is down the northern rivers, which will only float boats of shallow draught and several rapids necessitate the unloading and transporting of cargoes overland and loading on barges again. The cost of laying a pipe-line would be approximately $50,000,000.

ARIZONA

Bisbee. It is reported that the new sulphide orebody on the 600-ft. level of the Boras Leasing Co.'s mine is now 60 ft. long and 30 ft. wide averaging about 7% copper. The fourth monthly disbursement of 10c. per share was recently made. Production is being maintained at approximately 1250 tons of 8% copper ore per month.

Gunsight.—Seven men are at work constructing foundations for a cyanide plant that is to be erected at the New Gunsight mine.

Ray.—The new mill of the White Metals Co., erected by Kennard and Pierce, engineers of Los Angeles, is completed. The mill is a 50-ton flotation plant designed to treat the ore from the Pioneer mine. J. C. Devine is manager.

Oatman.—The east drift on the 400-ft. level of the Aztec vein of the Tom Reed has now penetrated the orebody about 100 ft. and is nearly 300 ft. west of the United American end line. It is reported that ore opened in the face of the tunnel contains $70 in gold per ton, and the vein is 3 to 5 ft. wide. The United American is cross-cutting 175 ft. above the level of the Tom Reed and should reach the same vein in 10 to 15 days.——The Telluride Mining Co. is now drifting on the vein on the 516-ft. level. It is reported that on this level a well defined vein has been opened which is about 25 ft. wide. Fifteen feet of this vein is quartz, one stringer of which assays $76 per ton in gold.

CALIFORNIA

Amador County.—An important strike has been made in the Plymouth Consolidated. On the 3050-ft. level a new ore-shoot has been cut at a point 100 ft. north of the main cross-cut. So far, for 140 ft. of drift, the ore averages an ounce of gold per ton for an average width of 10 feet.

Grass Valley.—The winze from the 400-ft. level of the Alcalde mine has been in milling ore all the way, according to a late report from the property, with considerable high-grade quartz in evidence. Ore containing free gold in a vein three feet thick has been found. As soon as the winze has gained the desired depth, cross-cuts and drifts will be driven out to develop the orebody. An electric hoist has been received and will soon be installed in the winze. The mill is being overhauled. Mining operations are rapidly becoming normal throughout the Grass Valley district as a result of withdrawal of restrictions regulating the use of electric power. The Empire company has resumed full operations at the Pennsylvania and Empire properties, and the Empire mill is running at capacity. The Idaho-Maryland is speeding up the work of unwatering its workings, and activity has been increased at the North Star, Boundary, Allison Ranch, and other properties. The shortage of labor is less acute and the general situation is encouraging.

Plumas County.—Persistent reports are current that the Plumas-Eureka gold mine, near Johnsville, has passed to the control of the Guggenheim interests. The property is situated near the Plumas copper-belt, but for many years was one of the greatest of Californian gold producers.

Work is being pushed rapidly at the property of the Reinmiller Copper Mining Co., situated in the Lights Canyon district. The company owns by location, bond, and option, approximately 50 claims, joining the Engels mine on the north.

The main development work done so far consists of one shaft 65 ft. deep, two tunnels approximately 70 ft. long, and five open-cuts. All of this work has developed copper ore containing some gold and silver.

Shasta County.—The Mountain Copper Co. has increased operations at the Hornet mine and the new crushing plant is handling 400 to 500 tons of ore daily. The plant is equipped with two sets of rolls and has a rated capacity of 600 tons per day. The ore contains pyrite and the product is shipped to San Francisco for conversion into chemicals and fertilizing agents. The company is erecting additional cottages near the mine for its employees. A large reserve of copper ore has been blocked out in the Hornet and Iron Mountain properties, but this product will not be mined until the market for copper improves.

Siskiyou County.—The Davis Consolidated, now that the Lagrange mine in Trinity county is shut-down, is the largest hydraulic mine in the State. Three giants are kept going and 16 men are employed. Five thousand inches of water is diverted from Indian creek and Girder creek through ditches that unite and deliver water at the giants through 32-in. pipe. Reeves Davis of San Francisco owns the mine.—— The old Washington mine near French Gulch is being operated by George E. C. Rousseau of San Francisco. Eight men are employed. This is one of the oldest mines in the French Gulch district.

Trinity County.—Operations have been resumed at the Bonanza King gold property, near Trinity Center, after an idleness of three months because of water shortage. The property is one of the largest producers in the county, and was formerly held by the Treadwell interests of Alaska and San Francisco. Scarcity of skilled miners is hampering activities.

IDAHO

Coeur d'Alene.—Better ore than found heretofore in the Hecla mine is reported on the 2000-ft. level. On this level the company is mining five feet of clean galena, without a trace of zinc. Besides this in the same shoot there is from five to six feet of good milling ore. This shoot has persisted for a long distance and on the 1600-ft. level proved 1800 ft. long.——The Bullion Mining Co. is proceeding steadily with development. The main tunnel has followed ore for 300 ft. This is at a point in the tunnel 4000 ft. from its portal and at a depth of 1000 ft. The orebody is wider than the tunnel. The ore contains $50 to $60 in copper and $7 to $8 in silver per ton. The tunnel has passed a point vertically under the No. 2 tunnel. The quantity of ore disclosed warrants the building of a concentrating mill.——The blower to be used in the new zinc unit of the Nabob Consolidated plant has reached the property. It is expected to increase the grade of zinc to 42%. Ore-hauling has been in progress between the mill and the railroad for some time. ——A contract has been let for the performance of several hundred feet of tunnel work in the Slavonian mine owning three claims east of the Last Chance and adjoining the Bunker Hill & Sullivan on the north. The work, which will advance the tunnel into promising ground, will be done with machine drills.

MONTANA

Butte.—It is declared that the market for zinc must rise to 9c. per pound before independent producers can operate at a profit. This estimate takes into consideration the amount of silver found in zinc ores of the Butte district. With increased freight rates, together with the greater cost of smelting, mining, and supplies, a ton of zinc concentrate is costing $30 more than the 10-year pre-war average, while only $4 more per ton is realized, due to the enhanced price of silver. An additional $16 per ton of concentrate can be included on account of increased price of zinc which theoretically leaves the producer with $10 less profit on each ton of zinc concentrate produced, than hitherto. The Anaconda company is making some profit on its zinc operations and there have been calls for increased deliveries of concentrate made to independent producers of the Butte district, but the market is so variable that from one month to the other zinc producers have no definite idea as to the outlook. Anaconda's operations on custom concentrate are more profitable than those on its own ores, which carry about 30% zinc as compared with 50% or more in the custom product. Butte & Superior had been shipping to Anaconda, but the bulk of its concentrate is now going to the plants of the American Metal Co. The Timber Butte Co. is shipping considerable to Anaconda. Anaconda is producing from 6000 to 7000 tons of zinc concentrate monthly from its own ores. The sentiment prevails here that the Joplin and Miami producers are smothering the spelter market through a disinclination to reduce their output sufficiently to stiffen quotations, and that if such a step were taken by those producers a betterment of spelter quotations would be had within a comparatively brief period.

UTAH

Salt Lake City.—A complete and authoritative map of the Tintic mining district, showing the property lines of all of the mining companies in the district, with groups of unpatented as well as patented claims, has been prepared by J. B. Ireland, whose office is in the Dooly block. The map is printed on sheets 17 by 28 in. A feature is the revision of the boundaries of the groups in the East Tintic section where the Tintic Standard property is situated.

WASHINGTON

Spokane.—A brief on blue-sky legislation has been prepared by the mining bureau of the Spokane Chamber of Commerce, of which F. W. Smith, smelter director for the Bunker Hill & Sullivan Mining & Concentrating Co., is chairman. The brief analyzes the Frawley bill and opposes its endorsement by the Chamber of Commerce as requested by the Better Business Bureau, an adjunct of the Spokane Advertising Club. It will be considered at a joint meeting of the committees and if adopted at that time will go before the trustees of the Chamber for consideration. While opposing the State blue-sky legislation, the brief advocates the enactment of a Federal law providing that full information shall be filed in the originating State of the corporation and at Washington, D. C. Also, it favors the automatic opening of all States to a promotion when it has been passed on by Federal authoritites at Washington.——It is reported that the Anaconda Copper Mining Co. may establish a mining and metallurgical department in this State. It seeks a source of aluminum and to this end has been engaged in the investigation of clay deposits near Mica, a few miles southeast of here.

HOOVER TO ADDRESS MEETING OF SAN FRANCISCO SECTION, A. I. M. & M. E.

Herbert C. Hoover, President of the American Institute of Mining and Metallurgical Engineers, will address the members of the local section at a meeting to be held at the Engineers Club on Tuesday evening, November 9. Dinner will be served promptly at 6 p.m.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Henry F. Collins is at La Espina, in Spain.

L. D. Ricketts is in New York, convalescing from an operation.

G. Allen Crane has opened an office as consulting mining engineer at Vancouver, B. C.

F. Lynwood Garrison is at Miami, Oklahoma, and will remain there until Christmas.

Herbert Hoover was at Salt Lake City last week on his way from New York to his home at Palo Alto.

R. L. Chase will be engaged on oil-shale examination work in western Colorado during the month of November.

John M. Hayes, treasurer for the Utah Copper Co. at Salt Lake City, has resigned, and will become a resident of Los Angeles.

L. R. Perry, of Forest City, Iowa, president of the Iowa Copper Co. at Park City, Utah, has been visiting the company's property.

Fred S. Stephen, president of the Dundee Arizona Copper Co., and **George Scott,** both of Dundee, Scotland, are visiting Jerome, Arizona.

Jack Flynn, formerly superintendent for the Jerome Copper Co., has been appointed general superintendent for the El Oro Railroad & Mining Co., at El Oro, Mexico.

Pierce & Skogmark, Inc., metallurgical and chemical engineers, formerly at 35 Nassau street, New York, are now associated in the practice of engineering work with **L. L. Summers & Co.,** at 140 Nassau street.

Olaf P. Jenkins has returned to Pullman, Washington, as professor of economic geology in the State College of Washington, having spent the last year with the Sinclair Exploration Co. as chief geologist in Alabama.

Obituary

Rutherford B. Sumner, mechanical superintendent of the International Smelting & Refining Co. at Tooele, Utah, died on October 25, of pneumonia. He was born at Northfield, Minnesota, 42 years ago, and after graduating from the University of Michigan, came West, accepting a position with the City Engineer's office at Salt Lake City. He became associated with the Tooele smelter in 1909 as chief draftsman, holding that position until 1917, when he was promoted to mechanical superintendent. He is survived by his wife, mother, and several brothers and sisters. He leaves a large circle of friends and business associates who mourn his untimely death.

Alexander J. McCone, president of the Fulton Engine Works, died in Los Angeles on October 27. He was born at Placerville, California, in 1860. He was educated at Santa Clara College and later took a business course at Heald's Business College. He became manager for his father at the Fulton Foundry in Virginia City, where he remained from 1876 to 1900; he founded the Fulton Engine Works of Los Angeles in 1890, moving the shop from Tucson, Arizona; in 1900 he established the firm of Harron, Rickard & McCone, which took over the business of Parke & Lacy, in San Francisco. He was interested in mining in Nevada, California, and Arizona, and a pioneer in the cyanide processes in Nevada, working the tailings from the Comstock mines. He moved the Fulton Foundry from Virginia City to Reno and established the Nevada Engineering Works in 1900, which built machinery for mines at Goldfield and Tonopah. He leaves his widow and four children.

THE METAL MARKET

METAL PRICES

San Francisco, November 1

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	16.50
Lead, pig, cents per pound	7.50—8.50
Platinum, pure, per ounce	$95
Platinum, 10% iridium, per ounce	$135
Quicksilver, per flask of 75 lb.	$60
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

November 1.—Copper is inactive but easy. Lead is dull and lower. Zinc is quiet and steadier.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Oct. 26	80.37	52.25	Sept. 20	94.31	60.08
" 27	80.37	52.12	" 27	93.52	59.66
" 28	79.87	52.00	Oct. 4	91.65	58.98
" 29	80.50	52.37	" 11	86.77	55.66
" 30	80.00	52.50	" 18	83.10	54.05
" 31 Sunday			" 25	79.52	52.31
Nov 1	80.75	52.87	Nov. 1	80.31	52.35

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug	100.31	111.35	86.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	93.66
Apr	95.35	101.12	119.56	Oct.	101.12	119.10	83.48
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound

Date		Average week ending	
Oct. 26	15.25	Sept. 20	18.75
" 27	15.12	" 27	18.70
" 28	15.12	Oct. 4	18.50
" 29	15.00	" 11	17.85
" 30	15.00	" 18	17.15
" 31 Sunday		" 25	15.75
Nov 1	15.00	Nov. 1	15.08

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	18.75
Apr.	23.50	15.23	19.23	Oct	26.00	21.66	16.53
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Oct. 26	7.00	Sept. 20	8.06
" 27	6.90	" 27	7.85
" 28	6.90	Oct. 4	7.54
" 29	6.90	" 11	7.50
" 30	6.90	" 18	7.50
" 31 Sunday		" 25	7.08
Nov. 1	6.90	Nov. 1	6.92

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	8.08
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	7.28
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	44.43
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	40.47
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Oct. 26	7.75	Sept. 20	7.85
" 27	7.75	" 27	7.73
" 28	7.60	Oct. 4	7.66
" 29	7.55	" 11	7.55
" 30	7.35	" 18	7.41
" 31 Sunday		" 25	7.50
Nov 1	7.35	Nov. 1	7.54

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.55	7.84
Apr.	7.04	6.49	8.76	Oct	9.11	7.82	7.50
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Oct. 19	70.00
Oct 5	75.00	" 26	65.00
" 11	75.00	Nov. 1	60.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	84.00	Aug	120.00	104.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	75.00
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec	115.00	95.00	....

ZINC PRODUCTION

At present the world's chief source of zinc is the United States, which gained supremacy in the zinc industry when the War eliminated Germany and Belgium from this field, says 'Commerce Monthly'. The United States had little export trade in this metal until the War forced foreign consumers to turn to American markets, but its trade is now in excess of that of any other nation and probably will remain so because of the continuing incapacity of the former producing countries to supply the market. The United States exported 109,232 tons of zinc in the first eight months of this year, or nearly ten times the annual amount exported before the War.

Belgium and Germany used to supply most of the international demand, but these countries are not now able to produce zinc to compete with the American product. In 1913 Belgium exported 194,513 tons of spelter, or more than nine times as much as did the United States. Although many of the zinc plants escaped destruction during the occupation of Belgium, others were completely dismantled. There has been a loss, moreover, through the disorganization of the skilled laboring force as a consequence of the War. At the same time there is a serious shortage of fuel and of zinc ore.

Unlike the Belgians, the Germans smelted principally from domestic ore. Present fuel and labor conditions, however, are not favorable for extensive zinc production in Germany. Although the ore is found in nearly every country in the world, the deposits in the United States and Germany alone of the chief smelting countries are sufficient for domestic requirements. Australia, the third largest producer of zinc ore and concentrate, has but a small smelter capacity and consequently has been Europe's chief source for foreign ore.

The attached table shows the exportation of zinc slabs and sheets from the United States:

Country	*1910-'14 (5-yr. aver.)	†1918	†1919	†1920 (first 8 mo.)
Belgium	700		3,725	3,965
Denmark	....	311	908	692
France	....	35,513	34,493	24,768
Italy	....	7,667	12,091	1,384
Norway	11	342	869	149
United Kingdom	5,682	35,274	59,489	68,253
Canada	4,601	8,048	3,746	1,618
Mexico	71	1,762	1,013	503
Argentina	8	583	735	861
Brazil	6	682	625	591
Japan	485	5,298	20,043	3,461
British South Africa	....	2,097	1,297	11
Portuguese Africa	....	659	322	3
Other Countries	262	2,077	2,508	2,973
Total	11,176	100,313	141,764	109,232

*Fiscal year ending June 30. †Calendar years.

The table shows how greatly Europe has come to rely upon American production for its zinc. The United Kingdom has regularly been the chief customer for American zinc, but the increase from an average of 5682 tons before the War to 59,489 tons in 1919 and 68,253 tons in the first eight months of 1920 is very striking.

MONEY AND EXCHANGE

Foreign quotations on November 1 are as follows:

Sterling, dollars	Cable	3 44 ½
	Demand	3 45 ¼
Francs, cents	Cable	6 38
	Demand	6 36
Lire, cents:	Demand	3.69
Marks, cents		1 28

Eastern Metal Market

New York, October 27.

Lack of demand still characterizes all the markets, and prices have fallen in all metals except tin.

Further offerings of copper have lowered values, and consumers continue out of the market.

The tin market has strengthened to some extent, but buying is on a small scale.

Conditions in the lead market are unchanged, but prices have fallen.

The zinc market is stagnant and values are a little lower for the domestic metal.

Antimony is stationary.

IRON AND STEEL

With no increase in new business, the downward tendency of iron and steel prices has been more pronounced. In coke, which has been the key to high pig-iron prices for months, the week has brought a further decline of $4 per ton, making a total of $6 in two weeks.

More mills have reduced output. Some of the lesser steel plants in the Pittsburgh and eastern Ohio districts have been more than 50% idle and six blast-furnaces in those districts have blown-out. The Youngstown plant of the Carnegie Steel Co. is operating but half its open-hearth furnaces. No change has been made in the Steel Corporation's price policy and any expectations of an advance by the corporation still centre in rails, concerning which an announcement is looked for before the end of the year.

Export sales have fallen off in a marked degree this month, the unfavorable credit situation creating an embargo against a growing list of countries. However, figures for September and October are expected to show shipments up to the average of more than 400,000 tons for each of the previous four months. Europe's markets remain in line with events here. Stagnation and plant shut-downs mark the situation in Great Britain and prices are weaker.

COPPER

The market has continued to decline until now either Lake or electrolytic copper can be bought at 15.25 to 15.50c., New York. This has been brought about by further offerings by various sellers, some of them large producers but the buying power is absent. Consumption has also declined and there is no denial that the stocks, or surplus, are large. How large they are it is difficult to say or ascertain. Certain press reports place it as 600,000,000 lb. In any event copper is below the cost of production for at least many companies and it is certain that the output will be curtailed further if it has not already been. Some companies are liquidating their surplus, or part of it, while others will not. The price is now down close to the low mark of 1919 and by many it is thought to have dropped too far. Whether the bottom has been reached it is difficult to say. About a week ago there was some spasmodic buying around 16c. but this has vanished. Better times are confidently predicted within a few weeks.

TIN

A moderate business was done the latter part of last week with dealers the principal buyers, but the British coal strike has put a further damper on business and this activity has disappeared. Those who did the buying considered tin cheap under 40c. and are looking ahead to higher markets or covering short speculative accounts. There were temporarily more buyers than sellers. On the New York Metal Exchange dealings are more numerous and totaled in the last week more than 150 tons. Of this two lots of 25 tons each of spot Straits tin were sold under the rule at 39.55c. and 39.30c., respectively. There were sales of future shipment of December-January at 40.37½c., of November-December at 39.75c., and of October-November Straits tin at 40.50c. A favorable outcome of the British coal strike is expected to send tin higher. Yesterday London prices took a decided jump, ending about £7 per ton higher than a week ago. Spot standard was quoted at £258 10s. per ton, future standard at £263 10s., and spot Straits at £260. These are all about £17 per ton higher than a week ago or on October 19. Arrivals thus far this month have been 1700 tons, with the quantity afloat 5025 tons.

LEAD

Demand continues light and the market is dull and easy. Domestic lead is lower and can be bought on a basis of 6.75c., St. Louis, or 7c., New York. Sales have been made at these levels. We quote the outside market at 6.75c., St. Louis, and 7c., New York. The leading interest continues to maintain its quotations at 7c., St. Louis, or 7.25c., New York. Imported lead is still available at 7c. on dock, duty paid, but the cost of importing is now less than this and therefore it is less of a factor than formerly. Importations on contract still continue.

ZINC

Prime Western for early delivery is easier and is obtainable at 7.10c., St. Louis, at which level small lots have been sold. Business is very light and producers continue their uninterested and waiting attitude, selling only what they must to cover immediate needs of regular customers. They refrain from quoting future positions. The same grade of zinc, sold for export and re-shipped to this country, is still available at 7.50c., New York, which we quote as the New York or Eastern market, but the quantity available is less than formerly, actual sales having disappeared some three weeks ago, but shipments are still being received.

ANTIMONY

Wholesale lots for early delivery are unchanged at 6.50c., New York, duty paid, with demand light.

ALUMINUM

The leading producer continues to maintain its quotation for virgin metal, 98 to 99% pure, at 32.90c., New York, for wholesale lots for early delivery. Other sellers are offering the same grade, mostly imported, at 28.50 to 29.50c., New York.

ORES

Tungsten: The market is stagnant and prices are nominal with Chinese ore quoted at $4.50 and Bolivian at $5 to $5.50 per unit in regular concentrate.

Ferro-tungsten is quoted at 90c. per lb. of contained tungsten guaranteed with 70c. asked for the unguaranteed while the powdered product is held at 78 to 85 cents.

Molybdenum: There have been offerings but no buyers and quotations are nominal at 75c. per lb. of MoS_2 in regular concentrate.

Manganese: There have been further sales of several thousand tons of foreign ore shipped to the United States at concessions from the previous prices realized. It is not possible now to state the consideration. The market is, however, generally weaker.

Manganese-Iron Alloys: There has been no change in the ferro-manganese market, the standard product being quoted on a basis of $170, seaboard, for either the domestic or foreign product. Re-sale alloy is still available in limited amounts at $155 to $160. The spiegeleisen market is lower and the high-grade product available and sold at considerable concessions below the hitherto prevailing price of $82.50, furnace.

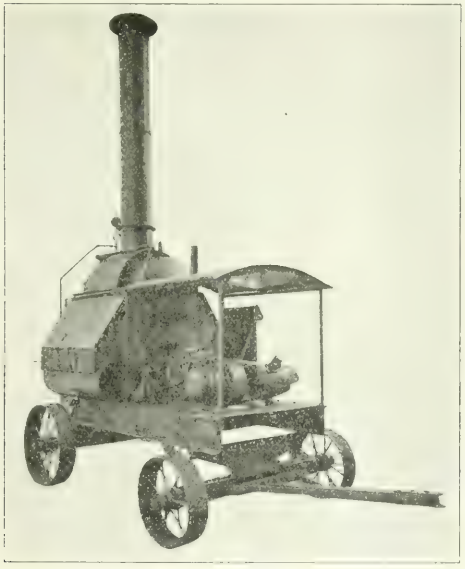
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

THE LUDLUM DYNAMOBILE

This new mobile power unit was designed and built by the New York Engineering Co., 2 Rector street, New York, for driving the small portable conveyors used in certain classes of mining in South Africa. Previously, power for this purpose was furnished by the old-fashioned reciprocating engine and portable boiler, with belt and pulley transmission to the conveyor. The object of the Ludlum dynamobile is to realize the utmost economy in generating power, and high economy and great flexibility in delivering that power to the driven mechanism.

The dynamobile consists of a special type of Ludlum



Ludlum Dynamobile

water-tube marine-boiler, a steam turbo-generator unit, switchboard, boiler feed-pump, feed-water heater, condenser, and, where the highest economy is sought, a superheater—all mounted on a steel frame carried on wheels. It is extremely simple in construction and in operation, is free from vibration, and is practically 'fool-proof' in construction. In the dynamobile illustrated, the boiler was designed for burning wood, the combustion-chamber being unusually large, but the outfit can be furnished for burning any kind of fuel. The combustion-chamber is entirely surrounded by the water-filled steam-generating parts of the boiler—this not only assuring high economy but also doing away with all fire-brick lining. The latter feature is of special value in a portable plant like this, as transportation over rough roads would break or dislodge a fire-brick furnace-lining.

The high efficiency of the boiler and turbo-generator set, and its compactness and light weight, makes the dynamobile a most economical and desirable unit for portable-power purposes, as it can be placed near its source of fuel and its power electrically transmitted to any reasonable distance with minimum loss. It is expected by the builders that this new high-duty portable plant will supplant the European outfits known as locomobiles and extensively used in foreign countries. The latter consists of an internally fired boiler of high efficiency with a reciprocating steam-engine, and contains many refinements making for economy; and in spite of the fact that it is very heavy and costly, it has found extensive use abroad because of its economy. The weight of the Ludlum dynamobile is only about one-third that of the locomobile and its price is much lower, while its efficiency is even higher than that of the European unit. The outfit illustrated is of 10 kw. capacity. Larger units up to 200 kw. are furnished, either A. C. or D. C.

TESTING OIL-SHALE

The Denver Fire Clay Co. gives the following method for preliminary or field distillation of oil-shales.

Before proceeding with the analysis the operator should understand that oil-shales do not contain oil as such. The oil is present in a substance known as 'kerogen' and can be removed by heating, without the presence of air, or destructive distillation, as the process is called. The method and rate of heating is very important, and upon this factor depends largely the type of oil that is produced from the shale.

To determine the oil-content of shale, first take a representative sample of the ledge and crush the shale so that it will pass through a ¼-in. mesh sieve. Thoroughly mix the crushed shale and weigh out exactly 8½ oz. Place this unit of 8½ oz. in a one-pint or a one-quart (the latter is preferable) iron retort. Seal the cover with our special cement, or with an asbestos gasket. If the distillation is to be conducted in the field, place the retort containing the charge of shale in a fire-clay furnace body. Connect a 1½-in. iron condenser to the outlet from the retort, and have it slope about 40° from the horizontal. A two to five-gallon water-reservoir should be mounted at a somewhat higher level than the condenser. This may be connected to the condenser by means of rubber tubing and then, whenever the water in the condenser becomes warm, it can be replaced by cool water from the reservoir simply by opening a pinch-cock. Place a 100-cc. graduated cylinder at the discharge end of the condenser, set the burner in place, and the apparatus is ready to use.

The best source of heat for field or laboratory use where gas is not available, is the 1½-in. DFC hydrocarbon burner, using gasoline for fuel. After one is familiar with the use of the apparatus a distillation can be made with from one to one and one-half pints of gasoline. Be sure that all joints are tight, then begin the distillation, turn the burner on full force, and leave the flame on full until the first drop of

water or oil appears in the graduate, then turn the burner as low as it will burn. The best results with the DFC burner will be obtained if the pressure tank is kept within the range of 45 to 55 lb. Keep the oil dropping from the condenser at regular intervals, but do not run it out too fast or the oil will be 'burned'. As the flow becomes sluggish, slightly increase the fire under the retort. Be sure to watch the condenser at all times and not let it become too warm, or part of the oil will pass out as a gas and not condense. After the oil has stopped flowing and the bottom of the retort is a bright red hue, shut off the heat, for nothing is to be gained by heating beyond this point.

The number of gallons of water and oil contained in a ton of the shale retorted, can be read directly from the graduate, for, if 8½ oz. is taken from the charge, then each cubic centimetre of oil which collects in the graduate is equivalent to one gallon per ton. The line of separation between the oil and water can usually be seen at once. If not, stir the contents and let the graduate stand for a short time and the division will become quite sharp.

The gravity of the oil may best be determined by pouring about 30 cc. of the oil into a glass cylinder, and then measuring the gravity directly by the use of a small hydrometer. It is desirable to use hydrometers which contain a temperature correction scale, especially when working outside during the hot summer months.

CUTTING A 44-INCH RISER

Heavy cutting with the oxy-acetylene flame has become so common that today nothing short of a super-cut attracts particular notice. A real super-cut was made recently in the plant of the National Car Coupler Co., at Attica, Indiana, when a cutter operating an Oxweld blow-pipe tackled a 44-in.

Oxweld Apparatus in Operation

(square) steel riser. The cut was rendered more difficult because of the upright position of the riser, which necessitated a horizontal cut. If the riser had been horizontal and the cut vertical the operation would have been much simplified. To offset this difficulty the operator resorted to first cutting the corners of the riser so as to reduce the uncut cross-section to a smaller square. This operation was repeated until the remaining stem could be easily cut through. The equipment consisted of the Oxweld cutting blow-pipe, Linde oxygen, and Prest-O-Lite dissolved acetylene. In this manner it would appear that there is no limit to the thickness of steel that can be cut with the oxy-acetylene torch, as the operation of slicing off angles can be carried to any desired extent so long as access to the metal with the cutting-flame is provided. With the injector type of blow-pipe the 'reach' of the flame enabled the operator in this instance to carry out the work by simply directing the jet through the initial kerf.

COMMERCIAL PARAGRAPHS

The Pennsylvania Pump & Compressor Co. has recently issued a number of bulletins describing its air-compressors and centrifugal pumps with details of their construction.

'Troy Trailers' is the title of a comprehensive publication issued by the **Troy Wagon Works Co.**, of Troy, Ohio. It points out that trailers should be specifically designed for the use desired, and detailed specifications are given of a number of typical designs, especially of contractor's side-dump ore-wagons. The publication is well and freely illustrated.

'Forged Fluid End Pump' is a 36-page bulletin (D-1302) distributed by the **Worthington Pump & Machinery Co.**, New York. It refers especially to heavy-duty pumps and to those working under pressures up to 10,000 lb. Pumps for oil pipe-lines and deep mines are standard equipment in this line, as also are high-pressure pumps for hydraulic installations.

The Pelton Water Wheel Co., of San Francisco, his issued a 48-page 'album' of views portraying typical installations of Pelton equipment of various sizes, from small units, driving exciters, up to the Drum plant of the Pacific Gas & Electric Co. with two 20,000-hp. turbines operating under a 1400-ft. head.

The present interest in oil-shale has moved the **Denver Fire Clay Co.** to issue a nifty bulletin (No. 25) on 'Oil-Shale Equipment'. The title is somewhat misleading in that it really gives interesting reference to information on the testing of oil-shale, the 'equipment', which is, of course, the Denver Fire Clay Co.'s apparatus, occupying but a small part of the bulletin.

Engineers and architects who are concerned with heating and ventilating-problems will be interested in a recent publication (68 pages) of the **Buffalo Forge Co.**, called 'Standard Pipe-Coil Heaters'. This publication, although called catalogue No. 460, has been filled with curves and tables to make it really useful, commencing with 'How to Figure Heater Requirements' to 'Final Temperatures and Condensations', and 'Properties of Air'.

Barber-Greene Co., Aurora, Illinois, has recently published its catalogue No. 4 of standardized material-handling machines, more particularly self-feeding bucket-loaders and portable belt-conveyors. The catalogue is filled with good illustrations of typical arrangements, and anyone interested in handling ore to or from stock-piles, cars, and storage-beds, or in excavating for foundations or building roads, will find much to interest him in the 32 pages of this publication.

The introduction of pulverized coal as a fuel has attracted attention to the difficulty of accomplishing the necessary drying of this inflammable material in an economical manner. **Ruggles-Coles** has issued its 'Catalogue Sixteen', which, although dealing with dryers for everything from aluminum hydrate to pitch and residuum ore, includes one class intended for drying combustible materials by direct heat, which obviously ought to be the most economical method.

T. A. RICKARD, ... Editor

HOW ignorant even well-informed persons can be concerning simple facts of industrial geography is suggested by a paragraph in the 'Boston News Bureau' expressing the hope that "the average Cornwall pit boy" will get hold of the idea that "the coal peace referendum is of rather more importance than a game of cricket". Cornwall is a land of granite and gneiss, in which veins of tin and copper may flourish, but not beds of coal.

DISMISSAL of the cases against all the remaining defendants held in connection with the Bisbee deportations of July 12, 1917, is announced from Tombstone, Arizona, where several of the cases arising out of that deplorable affair have been tried abortively. We are glad that the scandal has been quieted, for while we recognize that there was great provocation and some excuse for the exercise of violence against the alleged agitators and I. W. W., there can be, among good citizens, nothing but regret that any group of reputable men should take the law into their own hands.

FINANCIAL affairs in the United States cannot be understood without some knowledge of our Federal Reserve system of banking. It gives us much pleasure therefore to give our readers, in this issue, an article on this important subject by Mr. Edward Elliott, a director of the Federal Reserve Bank of San Francisco. Opinions may differ as to the complete success of the present banking structure and we are well aware that there be those who are critically disposed in this matter, but for ourselves we are inclined to give the Federal Reserve system credit for the stabilization of financial conditions in recent years, more particularly for the absence of panic during the crisis of the War and for the wonderful results obtained from the issuance of Liberty bonds.

ANNOUNCEMENT is made that the British government has lifted the embargo upon American exploitation of oilfields in British territory. This is a friendly and a wise step; as we have insisted more than once, it does not matter who exploits a country's mineral resources so long as the product goes into the home market; for example, it is not in accord with the national welfare to allow a British company to take oil from California to London, but any winning of oil in California by a foreign operator is unobjectionable, if not, indeed, desirable, so long as the product remains here for use by our own people. If foreign capital can be employed to develop a domestic mineral deposit, it is to our gain, provided the capital of our own people is remuneratively employed in other enterprises. If, however, we wish to guard against the exhaustion of a specific mineral resource, it matters little whether it is due to the operations of our own nationals or of foreigners. Our supply of oil being precarious, we ought to restrict exportation.

COPPER SHARES are in the dumps; on October 28 twenty of them averaged $29.51 as against an average of $72.14 in November 1916, when the artificial stimulus of war speculation sent them heavenward. Liquidation has been persistent and steady of late. The announcement by the Government that 574,000,000 pounds of copper has been reclaimed from new and old scrap during the past year was a shock to the market. This is a time to buy copper shares. The depression cannot last. A demand for metal on the part of the traction and telephone companies will make itself felt as soon as the public utility companies raise the fresh capital needed for the purpose. Now that the election is past and the movement of crops is nearly completed there should be signs of activity in this direction. The country is growing and its activities are expanding continually. These consume an increasing quantity of copper. And then there is the European market, which, so far, has been a cruel disappointment to the producers of copper, simply because we are still technically at war with some of our best customers.

UNDER 'Discussion' we publish a courteous demurrer from Mr. Charles K. Field, the editor of the 'Sunset Magazine', in reply to sundry criticisms, particularly from Mr. von Bernewitz, on his biography of Mr. Hoover. He makes so good a case that there is not much that we care to say, except that Mr. Wilson, whom he quotes as his authority for the details of Mr. Hoover's career in Australia, makes the blunder of assuming that Mr. von Bernewitz is a German. Names are unsafe indicators of nationality. Sometimes we think that people of obviously alien name ought to change it when they become naturalized as American citizens, but that, of course, is a matter of taste, and therefore not disputable. Mr. von Bernewitz, as our readers know, was formerly a member of our staff and before that he was our correspondent at Coolgardie, so he is likely to be well informed concerning

the matters on which he wrote. The present writer was at Coolgardie in 1897 and appreciates as well as anyone what Mr. Hoover accomplished in the way of improving the management of the mines under the control of Bewick, Moreing & Co. We know that Mr. Field had access to authentic data, and we do not doubt that Mr. Wilson proved helpful in technical matters. The 'life' appearing in the 'Sunset Magazine' was incomparably the best published during the period when it seemed likely, and we hoped, that Mr. Hoover would be nominated for the Presidency.

The Election

The result confirms the anticipations of most unprejudiced observers; it is an overwhelming victory for the Republican party. It is as well that the new President should have the backing of a Congress in which his own side is dominant. This will promote effective legislative action and place the responsibility squarely where it belongs. One of the anomalies of our political system is the possibility of a President being in office when the majority in either or both houses of Congress is in opposition to him and to the party that elected him. The result of the election is not related to the character or ability of either candidate; it hinged upon the personality and performance of the outgoing President. His position at this time has the elements of a Greek tragedy; only a mean man can fail to appreciate its intense pathos. He has had the solemn referendum for which he asked, and the American people, whom he represented with so great an authority and impressiveness before the world only a short time ago, has cast an unprecedented vote against his administration and his policy. He has been the victim of an extraordinary reversal of sentiment; he has been subjected to the most vicious personal attack and the most bitter condemnation at the hands even of his own friends. We deplore the vendetta that the senatorial camarilla waged against him, and the effrontery with which the President of the United States has been labeled un-American. With most of his policies we were never in sympathy; for his irresolution before we went to war we had a feeling of resentment; we did not respond to his idealism and we did not admire his obstinacy, but he has played a great part in human affairs and he has devoted himself with intense sincerity to the service of his country; therefore at this moment he seems to us a nobler figure than any of his detractors. He is a wreck, a pitiable wreck physically and almost broken mentally. Several of those who have seen him recently have recorded their impressions. He is stricken, aged, worn; his face is drawn and haggard; his eyes are dull and his voice is weak. A little over a year ago many of us saw him splendidly alert and vigorous, mentally and physically, a fine figure of a man. He sacrificed his health and his political career for the sake of the idea that was nearest to his heart. Today he is broken, humiliated, all his hopes shattered, all his policies frustrated, all his dreams ridiculed. We salute him with the deepest respect and the profoundest regret.

The Bounty on Gold

This is to be a special topic of discussion at the meeting of the American Mining Congress. As part of the record in the case we publish the report presented to the Secretary of the Treasury by the committee appointed to investigate conditions in the gold-mining industry; it seems to have been overlooked in the current discussion of this interesting subject. On that committee were two mining engineers, Mr. Emmet D. Boyle, the Governor of Nevada, and Mr. Pope Yeatman, a leader of the profession. The chairman was Mr. Albert Strauss, formerly a member of the Federal Reserve Board. Another member was Mr. Edwin F. Gay, formerly Dean of the Graduate School of Business Administration at Harvard, and now editor of the New York 'Evening Post'. To these was added Mr. Raymond T. Baker, the Director of the Mint. Evidently the committee was one well fitted to advise the Secretary of the Treasury. It will be noted that the report discusses the relation between the amount of gold available in a country and its credit during time of war. The structure of credit is bound to be high if the community—and the Government, we may add—is extravagant. Even the least observant will concur with this dictum, especially if the truth of it be impressed upon him through his pocket nerve. In time of peace, however, no impairment of confidence is threatened by a decrease in our gold production, says the committee. The question arises, are we at peace? Technically, we are not. Even if we were, would the conditions be those normal to a time of peace? Again, the answer is in the negative, although we agree that "in due time" there will ensue a restoration of all industry, including gold mining, to "a normal basis". It is the judgment of the committee that no steps should be taken by the Government to stimulate the production of gold. We are not surprised at this conclusion, for any interference with the buying and selling of gold, anything that affects our free market for gold, is not to be risked except under stress of acute necessity. This view, of course, is opposed by Mr. Louis T. McFadden, Chairman of the Committee on Banking and Currency in the House of Representatives, and the author of the Bill for paying a bounty on newly mined gold out of the proceeds of an excise-tax on the metal used in manufacture. In a hearing before the Committee of Ways and Means, he argued that the gold-mining industry would soon be "completely shut-down" unless assistance were forthcoming from the Government, and that the national credit was being impaired "by excess exportation and industrial use". Between May 1919 and May 1920 the monetary gold stock of the United States suffered a loss of $443,000,000. During 1919 the gold sold by the Mint for consumption in the arts amounted to $76,837,600. The output of gold in this country before economic conditions were changed by the War was $100,000,000; now it is half that. Suppose we restore production to the ante-bellum basis, that is, add $50,000,000 to our present output. What does that mean? As much as $50,000,000 of gold has been received at New York from Europe in one month; a single ship

has landed $17,000,000 in one day. Our foreign commerce amounts to $14,000,000,000 per annum. One must have a sense of proportion in matters of this kind.

Will the gold produced in the United States be available as a monetary reserve? Not necessarily; the amount of gold remaining in a country bears no relation to its production. The metal mined in South Africa is coming here; it does not remain there, nor does it stick in London. We question whether the gold reserve of the United States would be better protected by the McFadden bill, because our domestic output of gold, like that of South Africa, follows the tide of international trade. Suppose we do increase our production by $50,000,000; it will be effective only in so far as it increases the world's total stock of gold, which amounts to nine billion dollars worth. The ratio is $50 to $9000. At the end of last year just about half the visible supply of gold was in the United States. The world's total production up to 1919 is estimated at 19 billions, so that ten billion dollars worth has gone into the arts, has been hidden, or is lost. What has played havoc with the gold standard is not so much the decreased production as the enormous absorption of gold for hoarding and other non-monetary purposes in India and the Orient generally. Between 1914 and 1919 India absorbed half the world's production of gold during those five years. In the Malay States an American $5 gold-piece is at 25% premium over a five-dollar bill, because the natives want it to put away and to use for jewelry, the latter being a form of hoarding. A $20 gold-piece is at a premium of 5% only, because it is a unit too large for the average native. As Mr. Henry Strakosch has pointed out, the cheapening of gold in terms of commodities has enabled the Eastern peoples to pay more for it than the Western peoples are willing to give in order to secure it for monetary purposes.

A good deal of nonsense has been talked about Great Britain paying a premium on the gold mined in South Africa. Great Britain is paying no premium on gold. What has happened is that the British government removed the war-time restrictions upon free trading in gold and thereby bared the artificial status of the paper pound sterling, which at once was found to be at a discount in terms of gold or in terms of the dollar, which remained at a parity. The pound, the franc, the mark, and the lira have lost their purchasing power more than even gold has done, while the American dollar has become the standard monetary unit. When the miner at Johannesburg can sell his metal in London for 122 shillings, for example, as compared with the normal pre-war price of 84 shillings, he gets a premium of 45¼%, and as he pays for his labor and supplies in shillings, his profit is increased in proportion to the premium, which exactly measures the discount at which the pound stands in relation to the dollar, that is to say, the percentage of discount on British currency in terms of gold bullion is equal to the percentage of discount on sterling exchange in terms of American dollars. When gold sells for 122 shillings in London, the pound is worth only $3.38 in New York. If he buys machinery in the United States, the South African operator finds that his money brings him just as much less in dollars as his gold fetches more in shillings. If a Californian sells his gold in London he is paid in paper pounds and when he converts them into dollars, he finds that he has received $20.67 per ounce, less the cost of shipment and insurance, that is, he has received the price that the U. S. Mint is ready to pay him any day. If he buys machinery or supplies in England, he gets the benefit of the premium on the dollar or on gold, as you like to look at it. In regard to the so-called British gold supremacy, that also is a misleading phrase. In 1919, it is true, the United States produced only 16.6% of the world's output, whereas the British dominions produced 67%; but even that largely preponderant portion of the total production did not suffice to keep the pound sterling on a par with the dollar; in short, the supremacy of the dollar is a fact and "British gold supremacy" is a fancy.

It is asserted by our friends that our gold is needed to maintain the national monetary reserve. The bankers demur to this. A special committee of the Bankers Association has reported itself as "unalterably opposed" to the McFadden bill. It seems obvious that our domestic production of gold is no more likely to fortify our monetary reserve than the gold we import, on trade balances, from South Africa. The real thought behind the McFadden bill is to assist a worthy industry that is suffering from the abnormal economic conditions created by the War. We have more than a friendly interest in the gold-mining industry and we desire heartily to see it assisted in any way possible, short of doing anything injurious to the country as a whole. The best way to help gold mining, and copper mining, is to make peace with the countries with which we are still technically at war and to take steps that will stabilize peaceful relations between the others, and between them and ourselves. In short, the cure for the decadence of gold mining is normal economic conditions.

From Leadville to Cyprus

The mining engineer makes the whole world his patrimony; the American members of the profession have lived up to this tradition in recent years, although previously they were more stay-at-home than their English friends, for the good reason that our country happens to be continental in its extent and mineral resources. Latterly the American has been directing mining operations in the remotest corners of the earth, from Okhotsk to Tanganyika, from Suan to Chuquicamata. He has also investigated the ancient mining districts of that cradle of civilization, the Mediterranean. Not long ago we referred to the exploratory work done by engineers of the General Electric Company on the Sinai peninsula; this week we give sundry particulars concerning prospecting in old workings on the island of Cyprus. The information comes in the course of an interview with one of the leaders of our profession, Mr. Seeley W. Mudd, now a resident of Los Angeles. As a man is more interesting than a mine, so Mr. Mudd is more engaging than a

Cyprus prospect; or if you like to look upon a man as a 'prospect' in another sense, then you will find that the sample we have taken pans well; it shows the pure gold of good citizenship. Mr. Mudd is evidence for the efficiency of the American melting-pot; his forbears came from several racial stocks, which have been so roasted, smelted, and refined in the laboratory of American life and tradition that the product, after two or three centuries, is an unmistakable type, the *civis Americanus.* Mr. Mudd had the best education available in his youth, but he recognizes how much the technical training of today is better than that of forty years ago. Later he underwent an apprenticeship that an intelligent member of the younger generation might well envy. In the first place, he had a chance to do all kinds of work in a smelter immediately after leaving college, and then, when he went to Leadville, he engaged in the leasing of mines on his own account. We regard leasing as an invaluable experience, because it helps a young engineer to acquire judgment and initiative, besides teaching him unforgetably that the purpose of mining is to make money. It is not given to every young man to engage in mining on his own account, for to do that he must have some capital, but if he can obtain the experience it is likely to make him a reliable consultant in after years, provided the pursuit of wealth does not make him a wild optimist, which is the result of the *sacra fames auri,* as, indeed, of the hunger for baser metals. In our published interviews with successful engineers it will have been noted how often a successful turn in a man's career is due apparently to an accident. Mr. Donaldson chose to go to the mine in Oregon, thereby resigning the management of the Small Hopes to Mr. Mudd. On his connection with that famous mine he laid the foundation of his career. First he had the experience of managing the Small Hopes in its bonanza stage and later as a depository of low-grade ore. He was given charge of other mines distinguished by a variety of geologic structure and operated under diverse economic conditions. His leasing operations, as we have said, were particularly valuable in developing the qualities of discrimination and sagacity that became personal characteristics as he advanced in his career. In the end he became connected professionally with the biggest mining ventures in the West. The Ray laid the basis of his personal fortune. It is interesting to note his confident foresight in contrast with the narrow vision of the former British owners; when worked on a small scale as a high-grade deposit, the mine was a failure, but when exploited as an immense deposit of low-grade ore it was made enormously profitable, thanks to the constructive imagination of an alert and experienced engineer. An English mining engineer of recognized ability and high character, the late Alexander Hill, opened up the Ray in the first instance, unfortunately too soon to take advantage of the improvements in technical practice, in mine and mill, that made it possible to exploit copper ores with a cheapness now no longer remarkable. Mr. Mudd's adventure in the United Eastern was a smaller affair, but likewise extremely profitable. We have heard it said that the United Eastern, in plan and execution, was one of the neatest mining enterprises ever started and brought to fruition by one man or a group of men, for in all his operations, of course, Mr. Mudd has had the loyal assistance and intelligent co-operation of several friends, also mining engineers. That points at another characteristic invaluable in all kinds of large endeavor: he aroused loyalty and won whole-hearted assistance in his work. He does not play that miserable game called 'the lone hand'; he likes to have partners and he does not forget them in the hour of success. Moreover, the younger men tell us that he goes out of his way to help them and that he remembers his obligations beyond the letter of the contract; in consequence, he has what is too often denied to the rich and successful: he has the respect and affection that no money can buy. In his engineering work, when appraising a mine or in planning a scheme of operations for a new mine, he shows the care and caution that the circumstances require; he has no use for hearsay or guessing; he anchors his plans to the facts as determined by thorough investigation. He is not an optimist, nor a pessimist; he has a sense of the value of proportion. He can see the other man's point of view; and that makes him tolerant. A quiet philosophic appreciation of things as they are renders him fair in his judgment of the issues arising between capital and labor. His remarks on this subject indicate humaneness; they suggest that some men can acquire the privileges of wealth without forgetting their obligations as employers of labor. Enterprising always, in the later years of his life he has engaged in a romantic mining venture in Cyprus, where he, Mr. Philip Wiseman, and other friends have uncovered and explored sundry ancient copper diggings. He gives an interesting account of them. During the War this enterprise had troubles of its own, as might have been expected, but he forgot them in his devotion to the national service. As early as August 1916 he applied for a commission in the Engineer Officers Reserve Corps, and on February 12, 1917, he received his comission as a Major. In 1918 he was made a Colonel in the U. S. Army. He was assistant to Mr. D. C. Jackling, the Director of the Government Explosive plants, who had supervision of the building of the big Nitro works in West Virginia, a part of which only could be shown in the photograph that we print with the interview. In his concluding remarks Mr. Mudd exhibits the essential sanity and the cheery outlook that have marked him during the whole of his career. He believes in mining and has a worthy son to follow in his footsteps; he recognizes the broadening of the mining industry and the enlarged scope for engineering on a big scale; he is of the opinion that the code of conduct among members of the profession has improved. He has helped to improve them. He can look back and be grateful for unusual opportunities and remarkable good fortune, but most of all he is happy in having found work and opportunity for others, and for the many friends he has made. He has more than he knows.

Mr. Hoover's Biography

The Editor:

Sir—Some time ago you printed a communication signed Max von Bernewitz in which your correspondent complained at the "rubbish" contained in the biography of Herbert Hoover, published in the 'Sunset Magazine'. As examples of this rubbish your correspondent quoted our statement that Bewick, Moreing & Co. had an office at Coolgardie, whereas they had no office there and we should have said Kalgoorlie; also our statement that Mr. Hoover found that the miners were using the old 'double-jack' and that he introduced the single-jack into the mines and faced a rebellion of the miners.

In an editorial you commented very kindly on the quality of the biography we published, but you said, "Of course, the suggestion that Mr. Hoover or anybody else from the United States introduced the single-hand drilling practice into Australia is ridiculous. It was introduced into Australia, and into California, by the Cornish miners before Mr. Hoover was born," and further, "The pity is that these writers did not submit their manuscript, if not to their victim, at least to some competent mining engineer and one acquainted with Mr. Hoover's career in foreign lands."

I desire to say first that it was not intended to suggest that Mr. Hoover did more than introduce single-hand drilling into the mines immediately under his management; and, secondly, that it was not feasible to submit the text of this biography to Mr. Hoover himself because the author's method was personal and intimate in the extreme and it would have been a presumption to attempt to make Mr. Hoover in any way a party to any portions of the text as that might imply responsibility on his part for a variety of other details. But really, we did the next best thing in the interest of accuracy. In the case of the Australian chapter, regarding which your correspondent complained, the material was in the first place obtained almost entirely from George B. Wilson, a mining engineer, who was a college mate of Herbert Hoover at Stanford University and who was with him during practically the entire period of his residence in Australia, and in China as well. Not only did Mr. Wilson furnish the material, but he carefully read the galley-proofs. These proofs were also read by Theodore Hoover, Herbert Hoover's brother, and himself a mining engineer.

Mr. Wilson has made the following comment upon the communication and editorial in your journal to which I have referred:

"I read with interest the criticism in the 'Mining and Scientific Press' of August 28 of your biography of Herbert Hoover. Such contributions add nothing to the facts and belong to that class of criticism which discourages the publication of much valuable information.

"I am inclined to disregard all of Max von Bernewitz's statements, as his suggestion that Bewick, Moreing & Co. did not have an office in Coolgardie during the period in question proves quite conclusively that he does not know what he is talking about. Not only did they have large offices, assay-offices, and an engineering department in Coolgardie but they had no office in Kalgoorlie during 1897, if you except the office of the Hannan's Brownhill mine, which they managed.

"Plainly Mr. Max is guessing, but I am surprised at the editorial suggestion that single-jack drilling was universal in the mines of West Australia in 1897. I use the word suggestion advisedly because the editorial refers only to the introduction of single-handed drilling into Australia by the Cornishmen, which is cheerfully granted. However, the Kalgoorlie mines at the time in question contained as many aeroplanes as they did single-jack hammers. Mr. Hoover first introduced the single-hand hammer in the East Murchison United mine at Lawlers and it was here that the miners regularly buried them in the 'mullock' left in the stopes.

"I do not regard your article as in any way criticizing the Australian miner. The mining camps of West Australia were comparatively young in 1897 and their rich ores had rendered unnecessary a high degree of refinement in operation. In 1897 depth was being obtained in the development of the mines and the values were diminishing as the surface enrichments were being depleted. This rendered necessary the improvements in method and economies of operation which Mr. Hoover vigorously introduced. Nearly every mining camp in the United States has a similar history of early profligacy succeeded by sound methods and close economy as the ore values declined, and it is no reflection on the early management to relate this history.

"I note the editor's suggestion that you should have submitted your manuscript to some competent mining engineer acquainted with Mr. Hoover's career in foreign lands. As I am responsible for many of the facts contained in your description of Mr. Hoover's Australian and Chinese careers, including the facts previously commented upon herein, and because I carefully read your galley-proofs, I think you may claim to have forestalled Mr. Rickard's suggestion unless he takes issue regarding that word 'competent'."

We have been very appreciative of your commendation

of 'The Making of Herbert Hoover' and I hope your interest in the biography may be enhanced by this illustration of the pains we took to ensure its accuracy.

San Francisco, November 3. CHARLES K. FIELD.

[Mr. Wilson prefixed 'Herr' to Mr. von Bernewitz's name, and we deleted it, knowing that Mr. von Bernewitz is a native of New Zealand. We refer to Mr. Field's courteous letter on the editorial page.—EDITOR.]

Distribution of Power in California

The Editor:

Sir—In the issue of your journal of October 30 appeared an editorial reading in part as follows:

"As soon as the recent rains started to swell the mountain streams the State Railroad Commission gave permission to the 'movies' to run longer hours and to the merchants to light their show windows and electric signs more freely, but left the mining industry 20% short of its normal power."

To those unfamiliar with the facts this might be taken to indicate that the mining industry was being discriminated against and that the restrictions were still in force, although elsewhere in the same issue two separate items stated that the removal of power restrictions had permitted two mining companies to resume their normal method of operation.

During the summer restrictions affected the use of power during twenty-four hours of the day. Rains prior to October 11 made it possible on that date for us to remove restrictions from five P.M. to seven A.M. This applied to mining and all other industries, as well as the 'movies' and sign and window lighting. Two days later further rains enabled us to remove all restrictions except skip stops on the street railroads, and these were removed on October 17. Since that date no restrictions whatever have been in force.

The California Metal and Mineral Producers Association, which was in close touch with the power situation throughout the summer and actively co-operated with us to the end that the restrictions might fall as lightly as possible on the mining industry, feels, I believe, that no discrimination was intended or practised against that industry.

H. G. BUTLER.

San Francisco, November 3. Power Administrator.

Roasting and Chloridizing of Bolivian Silver-Tin Ores

The Editor:

Sir—I hope you will allow me some comment on the way in which my paper on the above subject has been abstracted in your issue of September 11. That part of my paper which deals with the unsuccessful methods of roasting is published nearly in full. However, the solution of the problem by feeding charges intermittently into a straight-line reverberatory furnace where the rabbles do not overlap, and where the state of oxidation of each charge is under positive control by keeping it separate from the others in its own section, is not emphasized at all, although I believe this to be an entirely new departure in roasting.

Chloridizing-roasting of silver ore has always been a bugbear to metallurgists on account of heavy losses of metal by volatilization. In the furnace which has been developed at Machacamarca silver losses are negligible. When drawings of this new furnace were submitted to one of the largest builders of machinery in the United States, the chief engineer in charge of the mining-machinery department, who himself had considerable experience in roasting, did not believe that the furnace would work. He thought that there would be no advance of ore in the furnace from feed to discharge-end, because the rabbles did not overlap, and that the ore would bank up against the walls, causing breakage of rabbles, etc.

The two furnaces now working at Machacamarca prove the contrary: another furnace with six spindles running on step bearings has been in operation since April and roasts and chloridizes seven metric tons per 24 hours. This is about the capacity that I predicted for a properly constructed six-spindle furnace, in my paper, which was written in December 1919. Several of these furnaces are now being installed at Machacamarca and at the mill of the Cia. Minera y Agricola Oploca de Bolivia, at Chocaya, and I expect that before long they will come into general use in Bolivia for chloridizing and roasting, although their field is not at all limited to that kind of work.

M. G. F. SÖHNLEIN.

Hilversum, Holland, October 3.

MONAZITE is mainly employed for the production of thorium nitrate, which yields thoria on ignition. The mixture of oxides in gas-mantles is derived from a mixture containing about 99% of thorium nitrate and 1% of cerium nitrate. Large residues of cerium compounds are obtained as by-products. The cerium required for the manufacture of the alloy ferro-cerium is obtained mainly from the residues in the manufacture of thorium nitrate for gas-mantles. This alloy typically contains about 30% of iron, and is used in the manufacture of sparking devices. Air-friction causes ferro-cerium to ignite when it is attached to a moving projectile, and for that reason it has been used to illuminate the path of shells. Among other uses of cerium compounds, mention may be made of their use for illuminating purposes in naval searchlights, their application in the manufacture of certain electrodes, and also of their use in medicine to a small extent. A special variety of optical glass containing cerium is made into spectacles for use by glass-furnace operators to avoid injury to their eyes. Monazite is the chief source of mesothorium, which closely resembles radium in its properties, and is obtained from the monazite as a by-product in making thorium nitrate. The amount present is only a few milligrammes per ton of the monzonite, and would be too small to make it worth while to work the monazite for the mesothorium alone. The mesothorium is sold on the basis of its radio-activity compared with radium bromide, and is at present (June 1920) worth [illegible] to $8 per milligramme.

CYPRIOTE BAKING BREAD

KHAN, SHIFT-BOSS HOUSE, AND COFFEE-SHOP

Seeley W. Mudd, and Copper Mining in Cyprus

An Interview, by T. A. RICKARD

You were born in the West, Mr. Mudd?

I was born at Kirkwood, a suburb of St. Louis, in Missouri, on August 16, 1861.

You come of English stock?

Of a complex mixture of English, Dutch, Polish, French, Irish, and Scotch. From my mother's side I can claim French Huguenot blood. My paternal ancestors originally came from Poland. On account of religious persecutions they went to England, where they remained for three centuries. When Lord Baltimore came to this country and founded the settlement in Maryland, two brothers of the name of Mudd were in the party, one or both acting in some secretarial capacity. Our family is descended from one of these brothers. A portion of an original grant of land near Baltimore from Lord Baltimore to one of the brothers is now held by my cousins.

You were educated at St. Louis?

At the Washington University of St. Louis, receiving the degree of Engineer of Mines in the year 1883.

What notable members of the profession were at this college in your time?

William B. Potter was at the head of the mining school. Arthur Thatcher and George C. Stone were assisting Professor Potter. Pope Yeatman, Joseph P. Gazzam, and Edmund B. Kirby were my classmates.

Looking back on this period of preparation, do you feel that the instruction you obtained at that time was suited to the making of your career?

ONE OF THE EXPLOSIVES PLANTS BUILT DURING THE WAR

The course we had at the Washington University was quite similar to and of quite as high a grade as that given in other schools at that period. I owe much to the opportunities I enjoyed there. As compared with the courses now given at the better mining schools it seems, of course, rather crude and decidedly incomplete.

What was your first job after graduating?

Immediately after graduation a half-dozen of us went to Ste. Genevieve, in Missouri, where there was a small copper mining and smelting enterprise under the superintendency of Frank Nicolson. Primarily we learned what we could, but all of us took shifts at the smelter; for some weeks we dumped slag-pots, fired furnaces, and helped generally around the plant. The shaft-furnace made a matte of 20 to 30% copper. This was re-charged into a reverberatory furnace, to be brought up to a black copper through the series of tedious operations then in vogue. The black copper was charged into a furnace like those in the Lake Superior region, and then slowly refined by poling. Occasionally we stayed on shift for 24 hours at a time watching these tedious operations.

You did not stay there long?

No. After leaving there I obtained a job as assayer under Samuel A. Barron, then superintendent for the St. Louis Smelting & Refining Co. at a lead-smelting plant five miles out of St. Louis. At this plant they were just completing some furnaces for reverberatory copper-smelting and there was in process of erection an electrolytic refining plant, one of the first in the country.

In what year was that?

1883.

What pay did you receive?

$60 per month as assayer. My experience at Ste. Genevieve proved valuable, for shortly after the copper plant was started I was able to help with the furnace work and without much delay was put in charge of the copper department of the smelter. From that time forward, while continuing to act as assayer, I was in direct charge of the reverberatory smelting and electrolytic refining under Mr. Barron.

How much was your pay raised on account of performing these additional duties?

At the end of two years I was receiving $125 a month.

You evidently made a good start and attained a position of responsibility in a short time. You must have enjoyed your work?

I did enjoy it. It was no eight-hour day; all the time was full of interest as well as work. Samuel A. Barron, who was then superintendent of the plant, has retired and is living now in Los Angeles. George D. Barron, his brother, was book-keeper at the plant and left for Mexico shortly before I went to Leadville. He is now living near New York City and is one of the directors of the American Institute of Mining and Metallurgical Engineers.

How long were you at this smelter?

[illegible] two years and a half.

Why did you leave?

Because of an opening at Leadville, Colorado. In December 1885, I went to Leadville with Charles M. Donaldson, who had just been made manager of the Small Hopes mine, then in bonanza and one of the great mines of the district. My first duties were those of ore-sampler. All the ore from the mine was shipped to the local smelters or to those at Pueblo and Denver. The sampling was done in Leadville. There I got into numerous discussions as to the accuracy of the sampling, which was rotten. Improvements were gradually introduced. The Small Hopes was then in rich ore, in places almost massive silver chloride. Some of the most beautiful specimens I ever saw came from this property at a depth of 200 feet. These were tempting to the ore-thieves, and after a few months investigation it became clear that there was a well organized system of stealing. A number of the thieves were sent to the penitentiary and many more were driven out of the district.

You must have become manager of the mine soon, because I remember meeting you at the Small Hopes and being taken underground by you, in September or October of 1886, I think.

I remember very pleasantly our numerous meetings in Colorado. I may have been temporarily in charge at the date you fix, but I was not made manager of the property until the summer of 1887. Mr. Donaldson left to take charge of the Eureka & Excelsior property near Baker City, Oregon. The financial group that controlled the Small Hopes, namely, R. C. Kerens, James G. Blaine, Senator Elkins, Senator P. B. Plumb, H. B. Denman, and Major Hood, most of whom were then active in politics, had purchased the Eureka & Excelsior; and Mr. Donaldson had received a letter saying that they wanted him to take charge of one mine and me to take charge of the other. Being a very young man, I told Mr. Donaldson that I would be glad to accept either one, and he chose to go to Oregon.

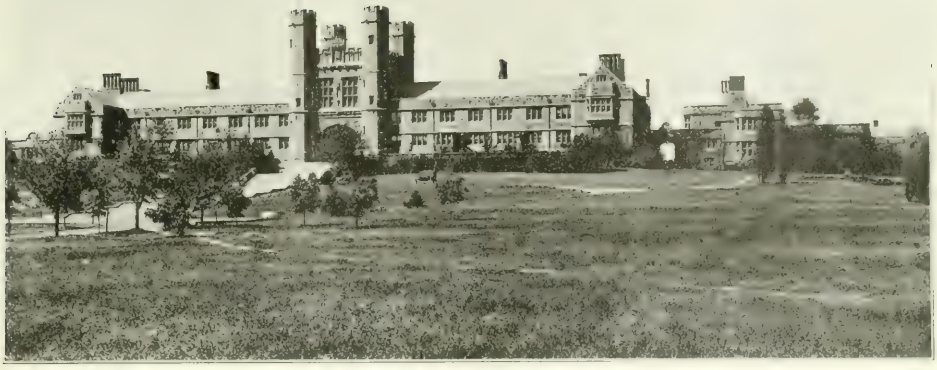
Well, Mr. Mudd, you were extremely fortunate, for I happen to know the career of the 'E. & E.', as it is called in Oregon, as well as of the Small Hopes. How long were you manager of the latter?

I was on the payroll of the Small Hopes for 25 years.

When did the mine cease operations?

The bonanza ore was exhausted in 1887. Thereafter more complete exploration followed and the old stopes were worked over and over as decreasing smelting charges and improved economic conditions generally made possible the shipment of low-grade ores. To bolster up the declining profits of the company, leases on other territory were secured, and for many years the exploitation of leased ground was by far the more important part of our work. The Small Hopes Consolidated Mining Company sold its property in 1912 to a local syndicate, which operated it for a time and then sold it to the Empire Zinc Company.

Was the Small Hopes became more important as a producer of zinc than of silver?



WASHINGTON UNIVERSITY, ST. LOUIS

The production of zinc has not been large.

How much lead and silver did the Small Hopes produce?

It was not a large producer of lead, most of the ore being 'dry'. The net profits of the company were between three and four million dollars. The gross yield from the smelters was between six and seven million dollars. During the bonanza period the total cost at the mine, exclusive of smelting, amounted to less than 15% of the amount received in settlement with the smelter.

What was the grade of ore during the bonanza period?

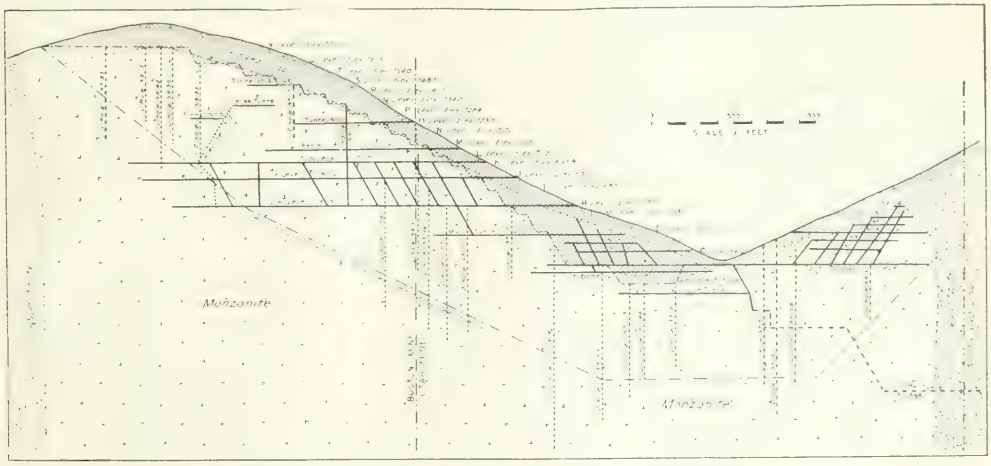
From 60 to 80 oz. per ton, as an average.

How would you compare the type of miner you employed at Leadville 35 years ago with those that you find now, for instance, at Oatman or even at Leadville?

When I went to Leadville, the miners at the Small Hopes were over three-quarters Cornish, with mining in their blood for generations. No better miners have ever existed. Gradually the percentage of the Cornishmen decreased and we got an increasing number of Americans and Irishmen. They too were excellent men after they had obtained the requisite experience. In Leadville most of the mining is done now by Austrians and Scandinavians, who usually are hard workers, but are not the equals of their predecessors in skill. I got so I could understand the Cornishmen fairly well, but with the Austrians and Finns the difficulty of language was insurmountable at times.

Will you say something about what is called the labor question?

The specific demands and immediate aims of labor today differ from those of the past, but human nature



LONGITUDINAL SECTION OF THE UTAH COPPER MINE

changes slowly and the present feelings of the laborer and capitalist are quite similar to those of the days gone by. Daniel Webster in 1833 described with remarkable accuracy the labor agitator and the feeling of unrest as they exist today. Labor has become dominant during recent years; it has grown so arrogant and unreasonable that the sympathy of the mass of the people is swinging away from the unions. Great power is dangerous and few have self-control, sanity, and tolerance enough to use it discreetly and well. Capital is apparently more sympathetic and just than ever before, partly at least because of necessity, and if the agitator who is disloyal to his country and intolerant of all difference of opinion can be deprived of his influence a speedy readjustment to a reasonable degree of harmony should take place notwithstanding the slackening industrial activity that is ahead of us. Intolerance of different races, of the followers of various religions, of the ambitions of different peoples and factions have caused most of the wars in history. Intelligent and sympathetic toleration of the viewpoint of the other side would soon draw labor and capital together, and would bring to our people a wonderful period of happiness and prosperity.

With what other properties were you connected at Leadville?

I was manager of the Leadville Consolidated Mining Co. and of the Boreel Mining Company for many years, and for a few years I was manager of the Ibex Mining Company, controlled by John F. Campion, A. V. Hunter, George F. Trimble, Eben E. Smith, and others. The Ibex mine was not only very rich, having produced more than any other Leadville property, but the ore occurrence was unusual and extremely interesting. I started leasing in a small way a few years after going to Leadville, and thereby became familiar with various parts of the Leadville district.

To engage in leasing is a good way of acquiring knowledge concerning a mining district.

Francis T. Freeland, whom you remember, used to say that Robert B. Estey and I started the plan, which has since become very common in the Leadville district, of leasing numerous tracts of contiguous ground and operating them as a unit. My first venture of this sort with Mr. Estey was started in 1893, when, after long negotiations, leases were secured from various owners on a number of pieces of ground at the east end of Fryer Hill. There was some question as to the title of parts of this ground and in one instance it was arranged between the two contestants that the royalty from any ore shipped should be held in trust until eventually through litigation it could be determined to whom it belonged. This operation was carried on under the name of the Union Leasing & Mining Company. Shipments were quite large for several years, up to 1897 or 1898. Without co-operation it was impracticable for any of the owners of small acreages to operate in that locality because of the amount of pumping that was necessary, but with control of a considerable area the operation became feasible.

What caused you to leave Colorado?

In 1887 I was married to Della Mulock. In 1901 we left Colorado on account of the health of one of our children, moving to Los Angeles, California. For two or three years thereafter I spent a good deal of time in Colorado, but gradually drew away from that State to the Pacific Coast.

What new mining ventures or professional work engaged your attention on this Coast?

For several years after moving to Los Angeles, I spent more than half my time in Colorado, in connection with the mining operations at Leadville, and also in connection with the work of the Empire Zinc Company, for which I acted as consulting engineer from 1902 to 1904. This branch of the New Jersey Zinc Company was under the local control of W. C. Wetherill, one of the finest and most charming of the older generation of engineers, and J. H. Troutman, who had been with the company for many years. This was to me a very pleasant association. The late W. C. Wilkens was in charge of the mining work for the company at that time and I got to know him intimately, to my great pleasure and advantage.

You got your first capital, I presume, by saving your salary and then by small participations with your principals?

No, not exactly. I saved from my salary and commenced to lease with Mr. Estey and others in Colorado. Before leaving Colorado I had acquired enough so that when I was offered the position of consulting engineer on the Pacific Coast for the Guggenheim Exploration Company I chose to have no salary but a rather larger compensation for anything that might be found.

How long were you consulting engineer for the Guggenheims?

Only two or three years, during which time I brought to their attention at least two properties in which they became interested, first, the Dairy Farm in California, and second, the Utah Copper at Bingham, Utah.

Yes, I had the pleasure of reading the report you made on the Utah Copper in 1905 and I remember particularly your diagnosis of the economic phase of the proposed operation. Why did the Guggenheims drop this business?

They did not drop it; they took up the first convertible bond issue at that time. The common stock was already in the hands of the MacNeill and Penrose group.

I remember very well that you were consulted with regard to the drainage system of Cripple Creek?

Yes, I spent a few weeks studying the drainage of the Cripple Creek district in 1902. The situation was an extremely interesting one. Over a large portion of the district, the watercourses were so intimately connected that at a distance of half a mile the water-level would vary only a few feet. One shaft would have no water to pump while another shaft a half-mile away might be pumping one or two thousand gallons per minute at a depth only five or ten feet greater, and when the first

THE RAY CONSOLIDATED COPPER MINE

shaft was sunk twenty feet the burden of the pumping would pass from the second to the first. In this basin at certain horizons it was necessary to remove over a hundred million gallons of water for each foot vertical that was drained. There was very little influx and when once drained the water gave little trouble. The old Standard tunnel discharged 17,000 or 18,000 gallons a minute for a few months and for almost two and a half years discharged an average of over 10,000 gal. per minute. The obvious solution of the problem was a drainage-adit. This plan was adopted and the Roosevelt adit was the first of the drainage-levels driven. David W. Brunton and A. E. Carlton contributed much to the success of the drainage scheme.

As you gradually withdrew from mining affairs in Colorado with what new enterprises did you become connected?

For the first few years much of my work was in connection with the Guggenheim Exploration Company on the Pacific Coast. I resigned in 1905. Early in 1907 the deal for the property now owned by the Ray Consolidated Copper Company came up. Philip Wiseman had seen this property some years before and was enthusiastic with regard to it. We tried for a number of months to get in touch with the right people. John Annan was the controlling spirit among the English group that controlled the Ray at that time, and William Young Westervelt was their American representative. The connection was finally made through Charles H. Cutting, then living in New England, and through Mr. Cutting an understanding was reached with Mr. Annan, then in England. This property had been worked for some time by the English company, but the enterprise had not been profitable and the company was being financed by a small group of stockholders led by John Annan and J. G. Gordon. The earlier attempts to work the mine had been made with the idea that the ore was of rather a high grade. These attempts were initiated before a railroad was built to the mine. Much development work had been done, part of it under the supervision and direction of Alexander Hill. A concentrator had been constructed and operated, and probably some concentrate had been shipped. This concentrator worked only the richer ore, but the development work had exposed two or three million tons of 2% disseminated ore and the various scattered shafts gave strong indications that the property was to become one of the great copper mines of the world.

Of course, by that time you had the benefit and experience of the Nevada Consolidated and the Utah Copper?

Yes, and it was that experience that made the property seem particularly attractive.

Will you not say something about the acquisition of the Ray property?

When I first saw the Ray, Mr. Cutting and Thomas Kavanaugh had exchanged letters with Mr. Annan in regard to an option. Mr. Kavanaugh was on the property and showed me on my arrival a telegram from a mining operator offering him a cash payment of $5000 if he would go back on the understanding that he then had with Mr. Wiseman and me. This did not tempt Mr. Kavanaugh for a moment. A complete agreement was finally made with Mr. Annan, and the Ray Consolidated Copper Company was organized with a capital of 600,000 shares of $10 each and an authorized issue of $3,000,000 of 6% bonds convertible into stock at $10. The shareholders of the English company that owned the property took $400,000 of bonds, 122,500 shares of stock, and $100,000 in cash for the property, which was deeded to the Ray Consolidated Copper Company. The purchasing syndicate paid $100,000 in cash to the English company, put $100,000 into the treasury of the Ray Consolidated Copper Company, and received in consideration thereof $200,000 par value of bonds and 127,500 shares of stock. The English shareholders gave to the purchasing syndicate an option on 61,250 shares, being half of their hold-

ings, at $10 per share, this option being valid until February 1, 1909. Mr. Annan laughed at the request for an option on a portion of their stock at $10 and readily granted it, but before the option period expired the development amply justified the purchase of this stock at that price.

When did Mr. Jackling get into the business?

The original financing was accomplished in February 1907 through Sherwood Aldrich, Eugene P. Shove, Charles L. MacNeill, and Spencer Penrose, all of Colorado Springs. I am not quite sure whether Mr. Jackling was interested in the beginning or not, but shortly afterward he did become interested and soon became chairman of the executive committee and managing director of the company.

Did you and Mr. Wiseman have any interest in the enterprise and do you still retain that interest?

Mr. Wiseman, Mr. Cutting, Mr. Kavanaugh, Robert

THE UNITED EASTERN MINE AND MILL

D. Grant, and I obtained an interest in the stock of the company and all the survivors of our little group are still interested in it.

To what figure did the shares that you bought rise?

I think $37 per share is the maximum price that has been paid for the stock on a capitalization of 1,600,000 shares. The shares that we bought from the English holders at $10 were on the basis of six million dollars for the property, the issue at that time being 600,000 shares. At $37 per share for 1,600,000 the property was valued at close to sixty million dollars. The stock prices for the last few years have usually represented a value of 35,000,000 to 40,000,000 dollars for the mine.

What are the prospects at the present time?

According to the annual report for 1919, the mine had 84,736,384 tons of ore averaging 2.063% copper, with possibilities for increased tonnage through extension of the orebody laterally and to a greater depth in certain portions of the property.

That must have been a most pleasant operation, both technically and financially. What did you do next?

Several smaller ventures followed. A very fortunate opportunity came in 1914 when Frank A. Keith got in touch with George A. Long and John L. McIver, who then held options on what is now the property of the United Eastern Mining Company. Mr. Long and Mr. McIver had worked underground in the adjoining Tom Reed property and had become convinced that the United Eastern ground would hold the continuation of the orebody. The data they had secured were not altogether convincing and it was only after several months of desultory discussion that an option was obtained from them at $25,000 for 51% of the stock issued. The shaft that they had started was pushed vigorously. All of the money paid for the stock was spent in exploratory work.

I suppose you would call this a beneficent wild-cat?

Yes, indeed, it was. We were very doubtful about the outcome, quite as doubtful as we have been with regard to many wild-cats that have long since been forgotten. It was one of the fortunate ventures that go to make up for the long years when one seeks and works and spends without any reward whatever.

Who were associated with you in this deal?

Frank A. Keith, Philip Wiseman, C. H. Palmer Jr., George D. Nordenholt, R. I. Rogers, J. E. Fishburn, and W. D. Woolwine.

How did the prospect pan out?

The shaft cut the vein at about 200 ft., but on that level only a few scattering assays were obtained. 250 ft. deeper a cross-cut to the vein went into bonanza, the vein showing from 20 to 25 ft. in width of $20 to $25 gold ore. This proved to be the top of a very rich and large oreshoot. A mill was erected and started in January 1917, and since that time has been running continuously, the tonnage having been gradually increased from about 200 to 300 tons per day.

How much has the mine produced altogether?

About 325,000 tons yielding over $7,000,000 gross, yielding a profit in excess of $4,000,000.

How deep is the mine now?

About 1300 feet.

Does the vein look healthy in the bottom?

The vein is of fair size in the bottom, but the ore has become poor. Further development will be done in depth in the hope that the ore may improve, and additional development work is in progress laterally. One of the greatest difficulties for the past two or three years has been the lack of men for work underground.

Speaking of the increased cost of gold mining, I would like to ask you what you think of the proposal to levy an excise of $10 per ounce on gold, as proposed in the McFadden bill now before Congress?

It impresses me as an extremely ingenuous and plausible proposal, but if passed, it will be because of the backing of the financiers, for there seems to be absolutely no chance of its passage in the interest of the producers of gold. The passage of this bill would increase the production in this country somewhat and the cost of it would be borne not by the Government but by the jewelers and other manufacturers in such a way that the people at

large would feel it very slightly. As to the soundness of it from a financial standpoint, I hardly know what to say. What is your opinion on that?

I think it a form of class legislation to which we ought to resort only in case of extreme national necessity, which I believe does not exist. In any event, unless I am much mistaken, the prospects of the bill passing Congress are and have been extremely small. You have been interested in a sulphur enterprise I believe in Texas, have you not?

Yes, about 1910 I was in charge of an examination of a sulphur property in Texas for a group of New York capitalists led by Bernard M. Baruch. At that time I asked my chief assistant, Spencer C. Browne, to look over Texas carefully for other possible sulphur-producing territory. This investigation indicated that the property of the Gulf Sulphur Company, near Matagorda, in Texas, was very promising. Shortly afterward negotiations were started and a stock interest was acquired. By 1917 nearly all the stock of this company, which owned about four hundred acres of ground, had been acquired. Today between two and three thousand acres are controlled. The name of the company has been changed and it is now known as the Texas Gulf Sulphur Company. During 1917 systematic development of the ground was begun, by drilling.

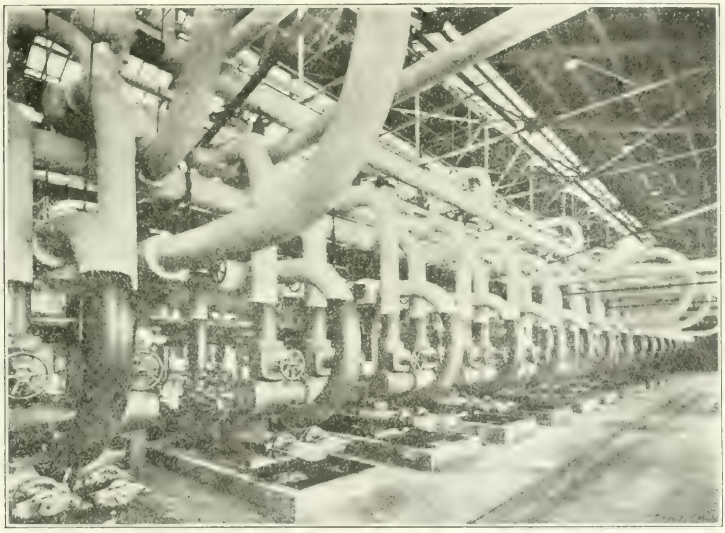
What kind of drilling?

With the rotary oil-rig, which is so commonly used in California. The overlying eight or nine hundred feet of material is made up of occasional layers of limestone in 'gumbo', which is a partly consolidated marine mud. The ordinary rotary drill was especially suited to penetrate such material.

How do you win the sulphur?

This is won by a process quite similar to that developed by Herman Frasch in Louisiana. The sulphur is melted underground by water heated to a temperature of 300° to 350°; after melting, it is pumped to the surface by an ordinary air-lift and is stored in vats made of planking. These vats are as much as 200 ft. wide, 300 to 1000 ft. long, and 30 to 50 ft. high. The sulphur is pumped from underground with little, if any, admixture with water and after being pumped into the vat it cools gradually, and solidifies. When the vat is full and the planking removed one sees an enormous block of solid sulphur lying on the ground. The sulphur is blasted and then loaded by a Brown hoist into railroad-cars.

For what purpose is most of it used?



PUMPS AND PIPING IN THE BOILER-HOUSE OF THE TEXAS GULF SULPHUR CO.

Much of it is used in the paper trade, much is used in making high-grade acid and also acid for the fertilizer industry, and a considerable tonnage is ground and refined for use in orchards and vineyards.

Can you tell me anything about the financial side of this enterprise, that is to say, how much capital was required and how fruitful it became?

The investment was over six million dollars. The result has been satisfactory, assuring an ample reward for the risk and expenditure involved.

Have you done any mining in foreign countries?

I have done more or less in Mexico, of course, but have never been connected with large operations there. I have been interested in ventures in other foreign countries, but none of them have come to fruition except one in the island of Cyprus. About ten years ago, Mr. Wiseman and I, together with three others who have since died or dropped out of the enterprise, engaged Charles Godfrey Gunther to look for likely property in this country and Mexico. After searching fruitlessly for several

years, it was decided that there was an opportunity around the shores of the Mediterranean. Under Mr. Gunther, search was made in the libraries of this country and Paris and London for information that would guide him to promising districts. On his first trip, after going to the Mediterranean, he started from the Red Sea with a dozen camels and as many cut-throats of the polyglot population and went to Mt. Sinai. There was copper there, but the conditions were not favorable.

Did Mr. Gunther find evidence of any large-scale copper mining operations?

No, not in that district. Apparently some copper had been mined on the Sinai peninsula and the evidences of turquoise mines were numerous. Mr. Gunther then visited a number of places around the Mediterranean, Northern Africa, Spain, Sardinia, Asia Minor, and adjacent regions, but he found nothing of exceptional interest until he went to Cyprus. That island shows the evidences of Roman and Phoenician mining at a number of points, but there are only a few where the slag-heaps indicate that the operations were large. The conditions existing at the place where the largest accumulation of Roman and Phoenician slags was found were so favorable that Mr. Gunther was confident that a mine could be uncovered. This was at Skouriotissa, five or six miles from Morphou Bay and about twenty miles west or south-west of Nicosia, the capital of the island of Cyprus. A prospecting permit covering a square mile was obtained from the English governor of the island. Mr. Gunther then returned to this country and about a year later took back with him a drill such as has been used to develop the 'porphyry' coppers. Drilling was started in the latter part of 1913 or the early part of 1914, and the present orebody was being developed when the War started between Germany and the Allies. Operations were hampered and finally drilling discontinued on account of a lack of supplies and it was not until about a year ago that our drilling was resumed. During the interval, however, Mr. Gunther did a large amount of underground work and built a railroad to the shore at Morphou Bay.

What is the character of the orebody?

The ore is a massive iron pyrite containing about 2¼% copper, something less than $1 in silver and gold, 47 to 48% sulphur, and is very free from arsenic and other elements deleterious to acid-making. The orebody now developed covers about twenty acres and has an average thickness in excess of 60 feet with a maximum thickness of 130 feet or more.

What evidences have you found of the work done by the ancients?

There is approximately one million tons of slag on the property, perhaps half of it having been made by the Phoenicians and half by the Romans.

What does the slag assay?

The Phoenician slag contains a little less than 1½% of copper; the Roman slag about ¾%.

Do you think there is any chance of beneficiating any of this slag, especially that left by the Phoenicians?

Yes, there is a possibility of developing very considerable bodies of the concentrated ore as well as additional tonnages of massive sulphides. A smelting operation would probably bring the Phoenician slag into use. There are several depressions in the surface indicating caved stopes below. Some old openings appear on the surface and large areas are covered with dumps from the ancient mining operations. Underground we have cleaned out two or three thousand feet of ancient drifts. These are small, about four feet high, rather less than three feet wide, narrow at the bottom, widening where a man's shoulders would have to pass through, and arched on top. The character of much of the ground was such that these drifts still stand perfectly, except at the intersections, or where the openings were unusually large.

Have you found any ancient implements?

A few lamps, which were made about the time of Christ. Sticks and fragments of pottery have been found, but no implements. Occasionally in the slag-dumps a little metallic copper is detected and one blacksmith's dollie was picked up, fashioned to put a blunt point on copper rods of four different diameters. Several spiral raises with a diameter of about 45 ft. have been opened up. These evidently were used for ingress and egress. At one point there is about an acre of fragments of ancient earthenware pots, which may represent the waste-heap of an ancient sulphur refinery, for in one of the caves the floor was covered to a depth of two feet with material that resembles the ash remaining after distilling sulphur, and in one corner of this ancient cave there was a broken pot partly filled with fine sulphur. Possibly water troubled the ancients and these earthenware pots were used by slaves in carrying water from underground.

You ought to find some implements in the old dumps?

The copper dollie referred to is the only one I know of.

Colonel Mudd, you did a good deal of work for the Government during the War, I believe. Will you please state the nature of it and the impressions that you obtained from it?

I was one of the assistant directors of the U. S. Government Explosive Plants, a separate administrative unit, set up by the Secretary of War. D. C. Jackling was director of this unit, whose principal work was the erection of the smokeless-powder plant at Nitro, in West Virginia, which was designed to produce 800,000 pounds of cannon powder per day.

The site selected was a cornfield; it was necessary forthwith not only to build wagon-roads and railroads, and erect the plant itself, but to provide dwellings, bunkhouses, restaurants, stores, Y. M. C. A., church, movies, hospital, electric lights, waterworks, and everything else to accommodate 20,000 people. By August, or within eight months, some powder was being produced in this plant. When the Armistice was signed, a plant with a rated capacity of 800,000 lb. of smokeless powder per day was 90% completed and the daily output had already reached an important figure. The plant included buildings and apparatus for making sulphuric and nitric acids,

for the purification and nitrating of the cotton; for poaching, boiling, dissolving, and transforming it into a jelly; for passing this jelly through the dies and drying, testing, packing, and shipping this powder finished and ready for use.

Finished powder varies in size of grain depending on its use. Small-arms powder has over 300,000 grains to the pound. 14-in. cannon powder has seven or eight grains to the pound, each grain being $1\frac{1}{8}$ inch in diameter and $2\frac{1}{4}$ in. long. It looks more like brownish molasses candy than like a violent explosive.

The Nitro plant is located in a bend of the Kanawha river and covers an elliptical area about $3\frac{1}{2}$ miles long and $1\frac{1}{4}$ miles wide. There were in all between 3300 and 3500 buildings constructed. The total expense was $60,000,000. From first to last 90,000 men were employed at this place, but at no time did the total number of employees exceed 19,000, excluding a military guard of about 500. The usual difficulties prevalent during that period were encountered in securing labor, supplies, and prompt transportation. Privately owned powder-plants grew like mushrooms between 1914 and 1917, and it is a satisfaction to know that America was able to supply not only her own needs but to furnish the Allies with large quantities of smokeless powder from a time shortly after Germany attacked France until the Armistice was signed.

There has been and will be much criticism of war work; but considering the lack of comprehensive general and detailed plans of all that was necessary to carry on a war, the urgency of the need, and the consequent sacrifice of everything to speed, the multitude of new things to be done, and the lack of training for these new duties, I consider the accomplishment of the nation and of nearly all the men with whom I was brought in contact was extremely creditable. The spirit of unselfish service was dominant in Washington and self-interest rarely obtruded itself. Mistakes and inefficiency were common enough, but this was inevitable in anything that had such a marvelously rapid expansion as the war activities of this country. It appears that the personnel of an army can be secured and given some training more rapidly than proper equipment and supplies can be provided. Military training of our young men is extremely desirable, but our people will make a greater mistake if they fail to force Congress to pass such laws and provide such funds as will ensure ample equipment and supplies for any possible future war.

Mr. Mudd, are your sons to become mining engineers?

One of them was graduated from Columbia college as a mining engineer in 1912. The other is studying medicine at the University of California.

How would you compare the condition of the mining industry as you knew it when you started with its status today?

When I started a trained engineer was subject to the sneers and contempt of many of the practical men. That is rapidly disappearing; the engineer is coming into his own. The spectacular development of the past few years in some of the enormous porphyry coppers has given us a larger perspective; it is not unusual now to look for a property having a life of ten or twenty years instead of as many months.

In other words, the industry has been stabilized?

Yes, decidedly. It is certainly much more satisfactory to have to do with an industry that is stabilized rather than one on which you cannot count from year to year.

How would you compare the standard of conduct obtaining in mining affairs 35 years ago with the present standard?

The standard has been raised very greatly. Collusion and dishonesty between the sellers of machinery and supplies and those in control of mining operations was frequent then, whereas now it is practically unknown. The standard with regard to the selling of stock to the public has also been raised considerably, but it needs further improvement.

How do you regard the opportunities offered to a mining engineer with those that were offered in your time?

They are better. His opportunity to obtain an excellent training with many of the larger corporations and better established engineers is larger and better than it was 35 years ago. The chances for stable and satisfactory employment are much more numerous. The openings for making money, while of a different type, are, I think, greater than they were.

Of course, the salaries paid today to a successful mining engineer and even to a young man are much higher than in your time and mine, and therefore a young man obtains the necessary capital with which to participate in mining operations much sooner than he used to?

Salaries are not only higher, but higher in proportion to the cost of living; opportunities for saving are greater, and the tendency to allow the young men to participate is also increasing.

You believe then that it is a good thing for the members of the profession to participate with their principals?

Yes, I do, but when this is done there must be absolute frankness, and even with this frankness, if the results are not satisfactory, one takes risk of criticism. It is good to risk one's own money on just the same basis as that of the other investors, or one's clients, showing good faith and confidence as completely as possible.

If it were all to do again, would you prefer to be in some other profession?

No, I know of none in which I think I could have gotten as much enjoyment, made as many good friends, and in which I would have had an opportunity to participate in the initiation of work that has meant opportunity and livelihood to so many.

EXPORTS of silver from San Francisco to China in August totaled 1,943,000 oz. The total export of silver into China for 1920 up to the end of August was 51,858,764 ounces.

Anaconda Enterprise in Chile

Although retarded by war conditions and great irregularity in receipt of supplies in South America, the development of the Andes Copper Co. has steadily progressed in the last three years. This company is owned by the Anaconda Copper Co. and part of the proceeds of the two $25,000,000 bond sales made by Anaconda in the last two years has gone into the development of its subsidiary.

The Andes property is situated about in central Chile, at an elevation of 10,500 ft., 100 miles from the sea-coast. The ore occurs in blanket formation and 120,000,000 tons of ore has been developed. There is still a considerable area to be drilled, in which there is every promise of adding to the ore-reserves.

Sixty miles of railroad connecting with the State railroad at Pueblo Hundido have been constructed and is at the present time in full operation.

The ore will be mined by the caving system, and will require no hoisting, everything being dropped through a system of raises to an adit to be completed within the next three or four months. When finished it will be more than two miles long. The ore will be transported by electric trains to the mill, six miles distant.

A town has been established at the mill-site, modern and up-to-date. An ample supply of water for the property will be brought from the higher points in the Andes, requiring three tunnels, work upon which is being pushed. A supply of water for camp purposes has already been brought into the property.

A great amount of research and experimental work has been done in the laboratory at Anaconda, and a process for the successful treatment of the ore has been definitely selected. Electric power is in use at the mine, generated at the coast in a plant capable of taking care of present needs. A larger power-plant has been fully designed and specifications for the same have been drawn. The whole enterprise has reached a stage where only delay in deliveries, excessive cost of materials and transportation are holding it back, and it is thought unwise to construct such a large plant under present conditions, as the treatment of from 12,500 tons to 15,000 tons of ore per day is contemplated. In the meantime development upon the property is being carried on, the heaviest portion of this work having been almost completed.

The Lo Aguirre and Africana mines, the property of the Santiago Mining Co., another subsidiary of Anaconda, are situated about 20 miles west of Santiago, Chile. The two mines are absolutely different in character. In the Lo Aguirre mine the ore occurs as a blanket deposit of oxidized ore, although recent development on the main haulage-level has shown a body of sulphide ore, averaging approximately 3%, the extent of which is as yet unknown. Winzes are being sunk at the present time to determine its depth. The greatest portion of the development work has been completed at this property, as it will be mined by the caving system.

The Africana mine, some six miles distant, has been developed through two vertical shafts, the main shaft being 700 ft. deep, from which levels upon the vein have been extended both north and south. The shafts are 2000 ft. apart. The ore in the Africana property occurs in vein formation.

Of course, the speed with which Anaconda brings its South American mines to the producing point depends on the copper market. There is no hurry now for an increased production of metal. But when the market shows some semblance of sustained business, these South American mines are confidently expected by the Anaconda management to be able to lay their metal down in New York as cheaply as, and in many cases more cheaply than, the majority of the mines of North America.

Opening Kegs of Blasting-Powder

It would seem as if opening kegs of black blasting-powder with wooden tools would be a perfectly safe proceeding, but according to a recent bulletin of the Bureau of Mines it is not. Among other things, it says: "Black powder may be ignited by direct impact, and the writer believes that this may occur without presupposing a preliminary spark. It is well known, however, that black blasting-powder is very sensitive to ignition by spark flame, or heated materials, and these may be produced by an electric current, by an open light, by incandescent particles from a pipe, cigar, or cigarette, by the tearing of metal sheets or scraping of metal against metal, and possibly by other means. The above statement will serve to introduce a newly recognized hazard—the ignition of black blasting-powder by the forcible opening of kegs with wooden tools. It has not been definitely established just how opening a keg with a wooden moil, wooden sprag, or a wooden mallet causes explosions, since it appears to be very difficult to strike a spark with wood against metal, but it may be that in breaking the keg, the sharp points of the sheet-iron would be driven inside the keg; that two or more of these points have been made; and that in rubbing over one another, these points or the edges of the strips have caused a spark; or it may be that the strips or points have been driven forcibly against the side of the keg and produced sparks, or it may be that the wooden tool was covered with a gritty substance, thus facilitating sparking, or it may be, and this has been demonstrated at the Explosive Experiment Station of the Bureau of Mines, that the fine particles of black blasting-powder remaining in the angular groove of the chime received the impact from the wooden tool and this ignited the particles.

"Regardless, however, of just how a spark may be produced, the evidence presented clearly condemns the method of opening kegs of black blasting-powder with wooden tools by punching a hole through the top of the keg. The usual 25-lb. black blasting-powder keg is provided with a bunghole and a cap for closing it, and in all cases, the powder should be poured from the keg through this bunghole. In view of the menace of other methods of opening the kegs, excuses for their use cannot be given serious consideration."

The Federal Reserve System

By EDWARD ELLIOTT

At its inauguration the Federal Reserve system was looked upon with disfavor and distrust by the majority of bankers, who resented what they regarded as Government interference. Its inestimable service in facilitating war finance through the mobilization of a large part of the financial resources of the country won for it almost universal appreciation, but the general reaction from war-time enthusiasms, the admitted inflation of credit, the high prices and the readjustments attendant upon the post-war period have combined to bring upon the system a variety of criticisms. It is, therefore, important that the organization and principles of the Federal Reserve system should be better understood, and some acquaintance with the events that preceded the enactment of the Federal Reserve Act will aid in a proper appreciation both of the changes in our financial system which it brought about and of the merit of the present plan.

Following the Civil War there was a period of high prices and credit expansion, which ended in the panic of 1873. Over-expansion resulted in a crash; deflation was abrupt and destructive. There was no machinery to check inflation or to bring about gradual deflation.

Recovery was slow, but the growth of population and the development of our natural resources were factors that greatly aided in the re-establishment of business prosperity. Yet, twenty years later, in 1893, came another panic of great severity. Again in 1907 the country experienced a panic, which differed from the previous ones in that it was primarily a financial as distinguished from a commercial panic. Business was booming—in fact, it was too prosperous, or rather it had expanded beyond the ability of the banking system of the country to take care of it—and so the panic of 1907 is often spoken of as a banker's panic.

What was then the banking system? In order to aid in financing the Civil War by securing a market for Government bonds, the National Bank Act was passed, by which national banks could be established in the various States of the Union under the supervision of the Comptroller of the Currency. His functions were limited to those of oversight—seeing to it that the National banks were properly organized and operated—or that the final obsequies of those which passed into the pale realm of insolvency were performed with due solemnity.

National banks were authorized to issue currency based on U. S. government bonds. This bond-secured currency was fairly profitable for the banks, but it was not elastic in volume; it could not be readily increased or diminished to keep pace with the increase or decrease in the volume of business. In addition to the National banking system, each State had its own banking system. By reason of the tax imposed by national law upon currency issued by State banks, they have ceased to be banks of issue.

The currency of the United States then consisted of national-bank notes, gold and gold certificates, silver and silver certificates, 'greenbacks' or U. S. notes, and fractional currency, none of which could be issued by the Government or by the banks in response to the needs of business.

With respect to both the National and State systems, it is to be observed that each was composed of separate and distinct units, in no way co-ordinated save in the matter of administrative supervision.

An important feature in any banking system is its reserve. It seems to be universally agreed that every bank should be required to hold a certain sum, which is fixed at a definite percentage of its deposits, as a reserve to meet the demands of its depositors; what this percentage should be varies from State to State, and in the national banking system and the Federal Reserve system, as well as in the State systems, it varies with the population of the locality and with the character of the deposit, whether commercial or savings. California State banks must maintain a 12% reserve against commercial deposits in a town or city, the population of which does not exceed 50,000; 15% when the population does not exceed 100,000, and 18% when above 100,000, and a 5% reserve against savings deposits. But only half of the reserve must be cash in vault; the other half may be deposited with another bank. While the States vary greatly in the percentage required, California will serve as an example. The same principle held good also for the old National Bank system. The cities under the National system were and still are divided into reserve and central-reserve cities.

For the clearing of checks and other purposes, country banks carry balances with banks in reserve cities and these in turn with banks in central-reserve cities, the balances formerly being composed in part of the reserves permitted by law to be carried in other banks. The practice became general among the city banks to pay interest on the balances carried with them by their correspondents. Against the deposit of the correspondent bank, the city bank was compelled to carry a reserve, half as cash in vault and half with another bank if desired. In order not to lose money by reason of the interest it was paying on bank-balances, the depositary bank was compelled to lend a certain amount of these bank-balances above the reserve requirement, and desire for profit led it to lend as much as it could. The result, then, was a succession of deposits, beginning with the country bank and continuing up to the New York banks. This was known as the pyramiding of deposits. Accompanying this was the lending of the deposits above the reserve up to the limit deemed advisable by each bank.

So long as times were quiet and there were no unusual

demands, the system worked fairly well, but when the country banks had a strong demand for funds and began to withdraw their balances, the city banks found themselves in an awkward position, for they, too, were doubtless having heavy demands from their customers, and to meet the calls of the country banks they began to call upon the banks with which they had made deposits. Finally, the demands converged upon the big New York banks. Having loaned by far the larger part of their deposits, their only resource was to call in their loans. The effect is obvious. The borrowers were called upon to pay at the very time it was most difficult to pay. There was first tight money and if the demands from the country and city banks outside New York continued, then a panic such as that of 1907 might ensue. If New York could not pay, nobody could pay.

Following the panic of 1907 and the discussion it provoked regarding a reform of our banking and currency system, Congress in 1908 appointed a National Monetary Commission, which undertook an exhaustive study of the banking and currency systems of all the important countries of the world. Its report, commonly called the Aldrich report, was made in 1912.

In every important European country there was a central bank, holding the reserves of the banks, serving as a discount market and having the power to issue currency. The report led to the introduction of the Aldrich bill in the Senate. This sought to give to the United States a similar central bank, but the closing months of the Taft administration were not auspicious for the passage of constructive legislation, and nothing was accomplished. President Wilson, upon his inauguration in 1913, called a special session of Congress for the purpose of revising the tariff. After months of effort, the Underwood Tariff Bill was passed late in the summer and Congress had hoped to be allowed to quit the heat of Washington and return home to rest and quiet, but the President addressed the Congress upon the need of banking and currency reform as a necessary complement to tariff revision in order that business might have the advantage of the aid that would come from needed reforms. Weary as it was from the tariff struggle, Congress took up the work of revising our banking legislation, and on December 23, 1913, the Federal Reserve Act was approved by the President.

The purpose of the new legislation was to remedy the evils of the old system by providing a central-reserve system, a steady discount market and a currency elastic in volume. The Aldrich plan had contemplated a central bank controlled by bankers. The Federal Reserve Act provided for a maximum of 12 Regional Reserve Banks, each under its own board of directors and all under the Federal Reserve Board. This Board is composed of seven members, of whom two, the Secretary of the Treasury and the Comptroller of the Currency, are members ex-officio, and five are appointed by the President for a term of ten years. The Federal Reserve Board is the agency through which the administrative centralization of the 12 Federal Reserve banks is achieved, but the powers of the board are not limited to mere matters of administration for the centralization, or rather unification of operation of the 12 banks, is likewise in its hands since the Board may compel one Federal Reserve bank to re-discount for another.

The 12 Federal Reserve banks have been likened to twelve reservoirs of credit; each member bank has its own pipe-line running to the reservoir and the twelve reservoirs are connected by pipe-lines to a central station, the Federal Reserve Board, which can direct the flow from one bank to another and thus adjust the credit-level in all—or, putting it in other terms, the Board can adjust the reserves of the different banks and maintain an average reserve percentage for the system.

Each Federal Reserve bank is governed by a board of nine directors, six of whom are elected by the member banks while three are appointed by the Federal Reserve Board. There are three classes of directors, called A, B, and C, composed of three each. Class C consists of the appointed members, one each year to serve for a term of three years. Class A are elected by the member banks; they are representative of the banks and are generally bankers. Class B are likewise elected by the member banks but are business men. The member banks are divided into three groups according to capitalization so that the capital represented in each group shall be as nearly equal as possible. This results in the few large city banks composing one group, the more numerous medium-sized banks of the larger towns composing another, and the very large number of small country banks the third. Each group elects one Class A and one Class B director once every three years.

This seemingly complicated procedure leads to the choice of three directors, one from each class, each year. The directors choose the Governor, Deputy Governor, and other officers who carry on the active banking operations. The Federal Reserve Board names one of the Class C directors as Federal Reserve Agent and Chairman of the Board. As Federal Reserve Agent he maintains a local office of the Federal Reserve Board in the Federal Reserve bank and serves as the connecting link between the Board and the bank. He also has custody of the Federal Reserve notes which he issues to the bank in return for gold or gold and re-discounted paper.

The growth of the Federal Reserve banks has been extraordinary. When the Federal Reserve Bank of San Francisco was opened for business on November 16, 1914, the entire staff, including janitor and watchman, numbered 22, and occupied a small space at the rear of the Merchants National Bank. Today it overflows a six-story building of its own and is beginning the erection of a permanent building, with more than double the present floor-space. In addition to the head office in San Francisco, there are five branches, at Spokane, Seattle, Portland, Salt Lake City, and Los Angeles, and the staff now numbers more than 1000. The territory embraced within this, the Twelfth Federal Reserve District, includes the States of Arizona (except the five south-eastern counties), California, Nevada, Utah, Idaho, Oregon, and Washington. It is greater in extent and more diversified in activities than any other district.

A Federal Reserve bank is often called a bank for banks. All National banks must be members, and eligible State banks may become members if they wish. A bank becomes a member by subscribing to the stock of the Federal Reserve bank of its district in an amount equal to 6% of its capital and surplus, half of which is paid in gold or gold certificates, and the other half is subject to call. Out of the net earnings of a Federal Reserve bank, its member banks are entitled to a cumulative 6% dividend upon the paid-up capital stock. The rest of the profits go into surplus until the surplus equals the subscribed capital stock; thereafter 10% of the net earnings after payment of dividends goes to surplus and the balance to the Government as a franchise-tax.

There are three fundamental principles of the Federal Reserve system: the centralization of reserves, the ability of member banks to borrow and re-discount, and the note-issue privilege. These three principles are so closely related that the absence of any one of them would render the operation of the system of comparatively little value. Let us consider them in the order named.

Every member bank now carries all its legal reserve with the Federal Reserve bank of which it is a member. The only cash in vault that a member bank need carry is the amount necessary to transact its daily business, or what may be called 'till' money; there is no legal requirement for vault cash. In view of the centralization of reserves and the re-discount facilities furnished by the Federal Reserve banks, the percentage of deposits that must be carried as reserve has been materially lessened. Before the Federal Reserve system went into operation, country National banks carried a 15% reserve against demand deposits; reserve city banks a 25% reserve, part cash and part deposits with other banks, and central-reserve city banks a 25% reserve, all cash. These percentages have been reduced to 7, 10, and 13, respectively, all with the Federal Reserve banks, thereby releasing for investment a large amount of funds previously tied up in idle reserves. The Federal Reserve banks pay no interest on the reserve carried with them. In view of the very large earnings of the Federal Reserve banks, the member banks have begun to urge that they should be paid interest on their reserve.

One of the bad features of the old system was the payment of interest on reserves, for it made it necessary for the depositary bank to lend out a large part of these funds. The Federal Reserve banks ought never to be required to pay interest on the reserves. They are essentially reserve institutions and they ought to be free to keep their funds in hand to meet any emergency and not be put under the pressure of earning interest on reserve deposits. Moreover, they are not money-making institutions, paradoxical as that may sound in view of their large earnings. They should never be regarded as money-makers for their members, lest a spirit should grow up which would lead to their control for the purpose of making money for the members instead of for the purpose of meeting the unexpected or unusual financial strain and of stabilizing business and financial conditions.

So much has been said on this subject, and bankers are sometimes so insistent that a larger share of the profits should go to them, that it is worth while seeing what justice there is in their position. The average banker thinks that the profits of the Federal Reserve banks have been made with his money and therefore he should share in them, and that if there were no Federal Reserve bank he would be getting interest from some other bank. Aside from any other advantages that have accrued from the Federal Reserve system, the percentage of reserve has been lowered and the average bank makes rather than loses. The question may be put in this way: Is a high reserve percentage, with low interest on half of it, more profitable than a low percentage with current rate on the amount represented by the difference in percentage? Let us take an example from a bank in a reserve city with $40,000,000 demand deposits. Under the old system its reserve would be 25%, or $10,000,000, half cash in vault, earning nothing, and half, or $5,000,000, with other banks at 2 to 2½%. At the latter rate, the interest per annum would be $125,000. This the banker thinks he has lost through receiving no interest on his reserve with the Federal Reserve bank. How does the matter stand in reality? As a member, the Reserve city bank with $40,000,000 demand deposits carries a 10% reserve, or $4,000,000, with the Federal Reserve bank without interest. But this is $6,000,000 less than formerly. At 6% the yield would be $360,000. Assuming that the bank might need $3,000,000 of this $6,000,000 as cash on hand or 'till' money, its income from this reserve released would still be $180,000, or $55,000 more than under the old scheme. In addition, it has the benefits of the Federal Reserve system. Moreover, the profits of the Federal Reserve banks have been made only through the use of them by the members. Every time a Federal Reserve bank makes a dollar, it is due to the fact that a member bank has borrowed or re-discounted, thereby securing additional funds to lend at a rate higher than the discount rate; or the Federal Reserve bank has bought acceptances in the open market that banks would otherwise have had to carry, and, as acceptances bear a low rate, bank funds are thereby released for more profitable use. As a practical proposition the payment of interest on deposits by the Federal Reserve banks would make them competitors of the city banks to the latter's detriment.

The centralization of reserves would be of little value unless accompanied by the ability on the part of the member banks to borrow from or re-discount with the Federal Reserve banks, since in this way alone can they draw upon the credit reservoir created by pooling reserves. A member bank may borrow from its Federal Reserve bank for a period not to exceed 15 days on its own note, secured either by U. S. government bonds and certificates of indebtedness or by paper eligible for re-discount or purchase. Banks ordinarily do not borrow money, although there may come times in the life of every bank when it is both necessary and proper to borrow, but it is supposed that the occasions will be rare and due to some temporary condition, hence the limit of 15 days put upon the time.

The Federal Reserve system has been subjected to

severe criticism from certain quarters because during the War it permitted the banks to borrow on their notes, secured by U. S. government obligations, and renewed these notes again and again, at the rate of interest borne by the bonds or certificates, sometimes even at a lower rate. This is really a criticism leveled at the method adopted by the Government in financing the War and raises a question that will be debated for years to come.

The opposing views may be stated briefly. The critics say that the bonds should have been issued at a going, or investment, rate, in which case the investors of the country would have bought the bonds and that the policy adopted of issuing the bonds at a 'patriotic' rate led to purchase on credit by people who were patriotic or who thought it desirable to appear so. Credit was thereby expanded and prices rose accordingly. The Federal Reserve banks, by making a low rate on loans secured by Government obligations, contributed to the inflation and filled their portfolios with non-liquid assets while at the same time they lessened their ability to meet the normal commercial needs of the post-war period.

It must be admitted that the credit expansion of the country has been a matter for the most serious consideration for more than six months and that as far back as the first of January the Federal Reserve Board and the Federal Reserve banks have given the matter their most earnest consideration, but they are unwilling to admit the justice of much of the criticism.

When the Government adopted the policy of marketing the bonds at a patriotic rate, the Federal Reserve system moved by the same spirit of patriotism which stirred us all, put itself and its resources at the disposal of the Government. Recognizing that Government obligations under normal conditions ought not to find a place in Federal Reserve bank portfolios, it was also recognized that the conditions were not normal and that to carry on the War successfully, the bonds must be sold; and no one can establish that the bonds could have been sold in any other manner.

In reply to the criticism that the rate should have been an 'investment' rather than a 'patriotic' rate, the view is expressed by some that no reasonable rate would have sufficed to find an investment market for the bonds because there was not surplus capital of 15 or 16 billions in the country. Others take the view that even if present, it would have been disastrous to offer a rate sufficient to attract it, since it would have been drawn away from enterprises necessary to the successful conduct of the War. Moreover, let us recall the psychology of the war days, remembering that at the outbreak of the War money was cheap, and it will be evident that the Government could with difficulty have carried through a program of war finance on any other than a 'patriotic' rate. There were enough slackers and malcontents without adding to their number by giving them opportunity to prate of the War as a rich man's war for the enrichment of Wall Street plutocrats. Moreover, the psychological effect of the patriotic appeal of the Liberty Loan campaigns would have been lost. In conclusion of the argument, it is maintained that the inflation, if an evil, was an unavoidable accompaniment of war finance, unless one were willing to strike out on a new and untried course and finance the war entirely by taxation or Government control and operation, at a fixed price for labor and materials, of all industries remotely touching the conduct of the War, which would have meant practically all industries.

In respect to discount operations, the Federal Reserve Act provides that notes, drafts, and bills of exchange made for an industrial, commercial, or agricultural purpose or the proceeds of which have been or are to be so used, are eligible for re-discount under regulations to be provided by the Federal Reserve Board. Industrial or commercial paper must have not more than 90 days to run, and agricultural—which includes livestock paper—not more than six months when presented for discount. No loan that has been made for investment purposes or for the purpose of carrying or trading in stocks or bonds is eligible. In addition to being eligible, paper presented for re-discount must also be acceptable. There must be a reasonable expectation that the paper will be paid at maturity, and to satisfy itself on this score the Federal Reserve banks may require every note presented for rediscount, unless secured by warehouse receipt, bill of lading, etc., to be accompanied by a financial statement of the maker, which must show an excess of quick assets over current liabilities sufficient to warrant the expectation of payment at maturity.

Let us see how the matter works out in practice. We will suppose my credit at my bank is good for $5000 and I borrow this amount on my unsecured note to buy stock or to build a house. If my bank wished to re-discount this note with the Federal Reserve bank, it would ask me to make out a financial statement, if it did not already possess one, and the note, together with a copy of my statement, would be sent to the Federal Reserve bank. There, upon examination of my statement, it would be seen that I was not engaged in business and was not a farmer and that the note had not been made for any one of the purposes allowed by law, and it would not be accepted. If, however, I were a manufacturer buying material with the proceeds, or a merchant buying goods, or a farmer buying hay or fertilizer or cattle, or harvesting my crop, the note would be re-discounted if my statement proved satisfactory.

In the face of the enormous re-discounts of today, it is hard to believe that six years ago, when the system was put into operation, banks were very unwilling to show re-discounts on their statements. The problem, then, was to get the banks to use the system; now, it is to find a way to limit them in the amount they may rediscount.

The Federal Reserve Act provides that there shall be no discrimination among member banks but that in accommodating one bank due regard shall be had to the interest of all other banks. When the credit expansion began to cause alarm last spring, Congress amended the Act, granting to the Federal Reserve banks the right to

put into effect a progressive discount rate in accordance with which a basic line of credit for a particular bank would be determined and any accommodation beyond this would be subject to a higher discount rate, which is subject to a progressive increase as the amount borrowed increases. Four of the Federal Reserve banks have applied the progressive rate, but its influence in checking expansion is problematical.

The Federal Reserve Bank of San Francisco has not adopted the progressive rate, but has required additional collateral, which serves to reduce the paper of the member bank eligible for re-discount with the Federal Reserve Bank and also to limit its borrowing capacity with other banks. The discount rates are determined by the boards of directors of the Federal Reserve banks, subject to the approval of the Federal Reserve Board.

The third fundamental principle is that of note-issue. Federal Reserve banks may issue Federal Reserve banknotes and Federal Reserve notes. The former is a currency similar to National Bank notes in that it is based on bonds and has been used chiefly to supply bills of small denominations. The latter constitute a currency intended to expand and contract in volume as the volume of business expands and contracts—an elastic currency. Federal Reserve notes may be issued against gold, or against gold and re-discounted paper. They are in the custody of the Federal Reserve agent and are issued by him to the bank. Under normal circumstances there must be at least 40% of gold back of every Federal Reserve note issued, the rest being re-discounted paper; but this limit of 40% may be lowered by the Federal Reserve Board.

Those who have followed the reports of condition of the Federal Reserve banks will have seen that the average reserve of the system has been for months in the low forties and there has been much discussion of what would happen should it fall below that amount. As a matter of fact, the reserve of individual Federal Reserve banks has fallen far below 40%, but by the ability of Federal Reserve banks to re-discount for each other, banks having higher reserves come to the help of the banks faced with demands beyond their means, and in this manner the average reserve of the system has been maintained above 40%. But nothing would happen if the reserves of the system should fall below 40%, that is, nothing in the nature of bankruptcy of the system. The Federal Reserve Board would simply lower the required reserve percentage. There is nothing sacred about the 40%, and it is possible that much of the discussion about the dangerously low point reached has been welcomed by the Board as a valuable adjunct to its general compaign to impress upon the bankers and the public the extent of credit expansion and the need for curtailment.

The credit-lending power of the Federal Reserve banks lies in their power to issue Federal Reserve notes. A dollar in gold in the vault of a bank is worth a dollar and no more. By no possible means can the bank make it worth more, but in the vault of the Federal Reserve banks it is worth two dollars and a half in credit, or Federal Reserve notes, if there is re-discounted paper in the hands of the bank.

Let us look at the transaction from another angle. John Smith is engaged in business and needs money to buy goods. He goes to his bank for a loan; his credit and his business are good, but his bank has reached the limit of its available funds, but if Smith's note is eligible for re-discount with the Federal Reserve bank, his bank, if a member, can make the loan for it, can immediately re-discount with the Federal Reserve bank and again be in funds. It gets from the Federal Reserve bank, Federal Reserve notes. John Smith's note may in this fashion be converted into currency up to 60% of its amount. John Smith's note would not circulate as currency but the Federal Reserve note will.

The ability of the Federal Reserve note currency to expand has been completely demonstrated, since there are now outstanding some $3,000,000,000 of such currency. It has yet to be determined whether it has the ability to contract with equal facility as the volume of business contracts.

During the post-war period of readjustment, the Federal Reserve system has had many serious problems to face, but none more serious than that touching its policy toward inflation and high prices. With respect to the latter, the position has been consistently maintained that it was not the function of the system to attempt to regulate prices. Its duty pertained solely to dealing with the credit situation and if in its action in relation to credit, prices were affected, this must be regarded as incidental merely.

As long as a year ago the expansion of bank credit was a cause of concern to the Federal Reserve banks and to the Board, and in November 1919 the discount rates were raised. It was supposed that following the crop-moving season, liquidation would set in, credit would be contracted, and the reserves would be increased; but instead of liquidation, there was continued expansion, with the result that in January rates were again raised. The normal effect of a raise of rates is to discourage re-discounts and to cause the banks to restrict their loans, but the conditions of the early part of 1920 were not normal. There was a spirit of extravagance and of speculation; production had fallen off and distribution was seriously curtailed by deficient transportation; goods and farm products were stored in warehouses and terminals and could not be moved; they were being financed in large part on credit and until they could be moved to the point of distribution and consumption, these credits were 'frozen'. Moreover, it was a seller's market; the public was insistent upon buying and price seemed a small consideration. In these circumstances a raise in the discount rate could not have its normal effect. But the action of the Federal Reserve banks in raising rates and the warnings of the Federal Reserve Board that the credit situation was becoming acute, focussed the attention of the country upon the need of conserving credit. Through the Federal Reserve banks and the member banks the borrowing public was impressed with the necessity of

curtailing its loans and of limiting credit to the essential industries. In a remarkably short time the psychology of the general public underwent a marked change. It was no longer recklessly extravagant and regardless of price. The public demanded lower prices; it became a buyer's instead of a seller's market. Merchants reduced their stocks and liquidated a part of their indebtedness. The bankers sought to eliminate all unnecessary and speculative loans, transportation improved, and some 'frozen' credit was thawed out.

The fear in the spring had been that the seasonal demands of the crop-moving season could not be met without a reduction of the reserves of the Federal Reserve banks below 40%. That danger seems past. Liquidation has, in some directions, taken place, though the total volume of loans has increased; legitimate and necessary business has been financed; inflation has been checked without panic; price readjustments have been taking place. In the process some individuals and some industries have been hurt. There has been no market for wool; financing of the cotton crop, wheat, and the live-stock industry has been difficult, but the policy of the Federal Reserve Board, aimed at the checking of expansion, and at the stabilizing of conditions to prevent a sudden crash, has met with marked success and approval.

Engineering Council

By E. H. LESLIE

A Department of Public Works of the Federal government as advocated by the Engineering Council of the National Engineering Societies was the subject of an interesting discussion at the recent meeting of the Council at Chicago.

For a great many years past it has been the practice of administrative offices to dump into the Department of Interior all matters of public welfare that did not fit in well with other branches of the Government. As a result the Department of Interior embodies so many different and unallied activities that efficiency and the best results have not been possible. The house-cleaning that is proposed is to establish a Department of Public Works, which will have within its scope all the engineering branches of the Government and, in a large measure, take on the present work of the Department of the Interior. It will, of course, have no relationship with Indian affairs, public health, and numerous other matters that at present come within the scope of the Department of the Interior. There has been considerable opposition to this movement on the part of the Army engineers by reason of the fact that such a department might supersede their present authority. It is hoped and expected that all the difficulties attendant upon the establishment of a Department of Public Works will be overcome, and new suggestions toward this end will be offered.

The report of the Patents committee was also of importance. It is hoped that the bill providing for increased pay to employees of the Patent Office will eventually pass Congress. There was a day when Government departmental employees could exist on the governmental honorarium. However, that day is long past and a salary commensurate with the value of services rendered is very much in order, or the whole work of the Patent Office will be impeded. The work of this office is of real importance to engineers and the public at large, and as it has never functioned on a par with similar departments of some of the other nations, there is lots of room for improvement. To provide salaries for the employees, compatible with what similar services outside the Office would command, will be a step in the right direction and tend toward a stronger and more efficient organization. The Council is in favor of such a bill and is giving it the full support of the Societies.

The report of the License Committee was another important matter that came before the Council and was the subject of considerable discussion and diversity of opinion. There were those present who believed that if a referendum to the engineers was made on the subject, there would be a large majority opposed to a license bill. The majority of the members of the Council believed, however, that such would not be the case. It was generally agreed that a license bill for engineers is something that all engineers must anticipate whether they want it or not. Such bills are now in force in a number of the States and other countries and are almost inevitable for this country. It is, therefore, germane to the work of the Societies to take cognizance of this movement and give direction to it. If engineers are going to be licensed, it is well that, among themselves, a program or bill be worked out that will have their approval. Just what defines an engineer under the proposed license bill was a matter of discussion. The fact that the term has been so widely and so wrongfully used, makes definition important. There are men in charge of one horse-power gasoline engines who term themselves 'engineers' as well as men who design and take charge of important engineering projects. In the wording of the bill, the phrase "professional engineers hereinafter called engineers" was adopted. The proposed bill will apply to architects, engineers, and land-surveyors. The report of the Committee on the proposed bill was accepted. Edwin Ludlow voiced the opinion that a license bill would prove exceedingly awkward to the consulting mining engineers, as it would necessitate holding license in numerous States as well as countries. Philip N. Moore was of the opinion that a referendum to the mining engineers would show them not in favor of a license bill of any kind. J. Parke Channing differed with Mr. Moore in this, which seemed to be the consensus of opinion of the Council.

The work being done by the Council is of no little importance to the professions represented and it is to be hoped that the present organization can be continued as a permanent body and its field of activities enlarged upon. The numerous public problems having a direct bearing upon the engineer, require authoritative consideration at the hands of men qualified to speak and as such a representative Council is a real asset to the professions represented and a help to the Federal government.

Report of Special Gold Committee to the Secretary of the Treasury

February 11, 1919.

To the honorable the Secretary of the Treasury.

Sir: On November 2, 1918, your predecessor appointed the undersigned a committee to investigate present conditions in the gold-mining industry and to study the problem carefully and thoroughly with a view to definitely ascertaining all the difficulties confronting gold production and submitting suggestions of sane and sound methods of relief.

The nature of the problem submitted to the committee was well stated in the letter of Secretary McAdoo to Delegate Sulzer of Alaska, under date of June 10, 1918, to which reference has been made in almost all resolutions or discussions of the subject since that time. That letter is reproduced herewith.

At that time the War was at its height and there was every prospect of a prolonged war. Contrary to the belief apparently entertained in many quarters, the structure of banking credit in any country during war times does not depend very much, if at all, on the amount of gold that can be made available as a reserve for that structure. Undoubtedly the rise in prices in this country since 1914 is to a great extent due to the heavy importations of gold during 1915 and 1916, but it does not follow that the export of a corresponding amount of gold at the present time would operate to bring down prices. As a matter of fact, it is the judgment of this committee that it would not so operate until we have reached or approached normal peace conditions. In time of peace the gold reserve is undoubtedly an important factor in controlling the credit structure, but in time of war that structure is determined by other causes. This distinction is sometimes overlooked and much inaccurate thinking is due to this oversight. Under war conditions the imperative necessity of the Government for the production of war essentials determines Government expenditures, and this expenditure cannot be modified to meet the banking needs of the country; on the contrary, the banking policies of the country must conform to the fiscal policy of the Government. Under these circumstances, the only way in which the expansion of banking credits can be checked is by a reduction of civil demands to correspond with the expanding needs for Government expenditure. The credit saved through this reduction of civil demands becomes available to the Government through the purchase of Government securities, or through the payment of taxes. To the extent to which such saving and resulting investment does not take place, Government obligations must be taken by the banks, giving rise to credits to the Government which create additional purchasing power for the use of the Government. This additional purchasing power, in turn, competes with the demands of private individuals, driving up prices against the Government and against the civil consumer and ultimately impairs the individual's purchasing power to an amount roughly equivalent to the impairment that might better have been brought about through voluntary saving. The credit structure thus erected depends inevitably upon Government needs and upon the willingness and ability of the community to impose upon itself voluntary restraint in expenditure. In other words, the structure will be high if the community fails to save.

The results in saving achieved in the United States were remarkable, but no program of saving can be instantly put into effect, and the expansion of the credit structure that took place under these circumstances was inevitable and could not have been controlled through any reduction in the gold reserve.

This being so and a long war being believed in prospect, it was important to maintain a strong gold reserve in order that there might be no impairment of confidence in the convertibility of our currency and in our ability ultimately to settle any international indebtedness in gold.

The cessation of hostilities has radically changed this situation, and, with the change in the situation, any need of particular effort to promote or stimulate our gold production which may have existed has ceased. There is now no danger of an impairment of confidence. The dimensions of our financial problems are becoming clear, and we know that we can without permanent strain meet any financial requirement the Government will be willing to assume. Some further expansion of credit may result from our expenditures for demobilization and readjustment, but we can look forward to a comparatively early contraction of our credit structure with the attending circumstances of a free gold market and a gold reserve that shall once more perform its normal function of regulating credit conditions. That movement will, we believe, be both preceded and accompanied by lower commodity prices.

Under these circumstances there is, in our opinion, no need for artificial stimulation of gold production. Not only has any need therefor passed, but there have come into operation causes that will in due time restore all industry, including the mining of gold, to a normal basis. Gold mining will then become again normally profitable and respond automatically to normal stimuli.

It is therefore the judgment of this committee that no steps should be taken by the Government to stimulate or promote the production of gold.

The representatives of the gold-mining interests very properly based their suggestions for relief on the public

necessity for a larger production of gold and not on the hardships suffered by them as parties interested in an industry in which the margin of profit had been turned into a loss. They recognized that such diminishing profits and such losses were inevitable under the shifting conditions of war, and that merely as producers they had no better claim to relief than any other section of the community suffering a reduction of profits or incurring losses under the changing incidence of war conditions.

In the course of its consideration of the subject referred to it this committee has conferred with a committee appointed by the American Gold Conference held at Reno in August 1918, under the presidency of Gov. Emmet D. Boyle, of Nevada; it has had the benefit of the very complete survey of the conditions of the gold-mining industry contained in the report dated October 30, 1918, of the committee appointed by the Secretary of the Interior to study the gold situation, of which Hennen Jennings, Esq., was chairman, and of the report dated November 29, 1918, of the gold production committee appointed by the commissioners of the British treasury under the chairmanship of Lord Inchcape; they have conferred with or secured the views of Prof. Irving Fisher and other eminent economists, besides which they have had referred to them a considerable volume of correspondence expressing widely varying views which had been received by the Secretary of the Treasury and the Director of the Mint.

It is interesting to note that the British treasury committee arrived at the same conclusion as that which we have reached.

We can not refrain from expressing gratification at the substantial unanimity of opinion among those whose position or experience entitled their views to respectful consideration against suggested measures of relief that would have had a tendency to undermine or upset our standards of value.

Respectfully submitted.

ALBERT STRAUSS.
EDWIN F. GAY.
RAYMOND T. BAKER.
EMMET D. BOYLE.
POPE YEATMAN.

Oil-Pipe Lines

*The pipes for conveying oil are laid on the surface of the ground, or at a depth varying from 18 in. to 3 ft. beneath the surface, and the main lines are generally 8 in. diameter. The oil is forced through the pipes by means of pumps operated either by steam or by internal-combustion engines. The pump stations are situated from 1½ to 90 miles apart, varying with the condition of the country through which the pipe-lines extend, and the viscosity of the oil to be handled. As stated, the size of pipe generally used is 8 in. diameter. The specifications require that it be of a uniform quality, and of steel, that the threads be carefully made so as to make as perfect a union between joints as possible, and that it be capable of safely withstanding an internal pressure of 2000 lb. per square inch. It is estimated by the U. S. Geological Survey that the total mileage of oil trunk lines in the United States today is approximately 34,000, and that the gathering systems, which are a fundamental part of the trunk systems, aggregate about 11,500 miles in length, making a total of 45,500 miles. At the time most of the lines were constructed, the average cost per mile based on 8-in. pipe was about $6500. The cost of the average pump station at that time varied from $130,000 to $250,000. The cost at the present time would be much in excess of these figures on account of the increased cost of equipment and the labor of installing.

The difference between the published pipe-line tariff-rates and the railroad rates for shipping crude oil have always been so large that refiners and producers, even though they have no pipe-line systems of their own, cannot afford to ship by rail, except for comparatively short distances. The pipe-line rates, although greatly increased in recent years, are still much lower than those charged by the railroads for tank-car shipments. It is evident, therefore, that because of this relative cheapness in transportation, so long as the oil industry endures the pipe-line systems of the country will be a very important adjunct to it.

The viscosity of the oil to be transported, and the topography of the country through which pipe-lines pass, are the governing factors determining the distance between pumping-stations. The average distance between pumping-stations in the Midwestern and Eastern States is about 35 miles, while the average distance between stations in California, where a relatively thick viscous oil is handled, is about 12 miles, although, as pointed out above, stations are sometimes not more than a mile and a half apart, and in extreme cases are placed as much as 90 miles apart. The equipment of a pumping-station depends primarily upon the quality and quantity of the oil to be handled. It depends also, to a certain extent, upon the fuel and water supply. Equipment is usually provided in excess of ordinary demands, so that there is always in reserve extra pump-power to meet unusual demands, thereby avoiding shut-downs where repairs are needed to pumps and boilers. As has been pointed out, the usual form of motive power are steam-engines and internal-combustion engines. The pumps are designed to deliver through an 8-in. pipe-line approximately 30,000 bbl. of oil in 24 hours, working under a line pressure of 700 to 900 lb. per square inch.

*Abstracted from a bulletin of the U. S. Bureau of Mines by C. P. Bowie.

THE AVERAGE MONTHLY production of copper in Mexico has reached 4,681,020 lb., according to reports of the Department of Industry, Commerce, and Labor of that country. The average monthly production of gold, according to the same authority, is now 1965 oz. and of silver 170,824 oz. At the present time there are in Mexico 60,569 denounced mining claims, 2017 of which were denounced prior to 1892. Taxes are being paid on 30,990 claims, while 3867 claims are reported as being actively worked.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

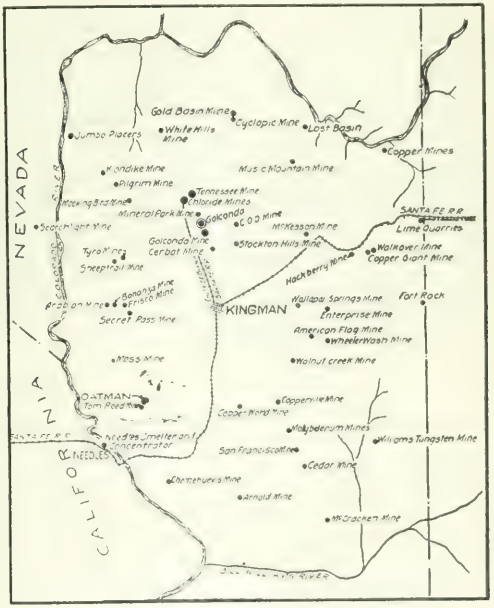
ARIZONA

BISBEE MINES ARE CURTAILING FURTHER.—MINERS ARE LAID-OFF.

BISBEE.—The Denn-Arizona Mining Co. ceased operations on October 30, except for pumping, and laid-off approximately 100 men; this action being taken on account of the condition of the copper market. The Shattuck-Arizona company and the Shattuck mill, which are under the same management, will continue to operate for the time being at least, on the same basis as heretofore. This announcement, in conjunction with that of the curtailment of work on Sacramento hill, by the Phelps Dodge interests, causing a lay-off of about 350 men on November 1, comes as a decided blow to the district. That it is a temporary condition that will change as soon as there is an improvement in the copper market, is agreed generally among local mining men.

The crisis in the copper market is only temporary, according to G. H. Dowell, general manager of the Copper Queen branch of the Phelps Dodge Corporation at Bisbee. "The Copper Queen has at this time more than seven months production on hand," said Dowell, "which aggregates about 35,000,000 lb. of copper. Wages and supplies have been high and it has cost about 18c. per pound to produce the copper. The present prices of copper are in my mind artificial. They have not been governed by the law of supply and demand." Mr. Dowell said that it is impossible to close down, but that operations must be curtailed to a minimum—probably less than 50% of normal. He declared that with the present cost of supplies and wages, and the present price of copper, it is impossible to operate at a profit. With an improvement in the situation Dowell said that the company plans the expenditure of three or four million dollars on its reduction works at Douglas. Experiments with this in view have been carried on there by H. H. Stout.

JEROME.—The United Verde Mining Co. of Jerome laid-off 30% of its men on November 1. H. Dewitt Smith, superintendent of mines, said: "Our action in laying off practically one-third of our men, is due simply to the fact that we cannot sell our copper. No men with dependent families are being laid-off. We are laying-off only single men, or men whose families are not living with them in Jerome. I should say that about 75% of our single men will be laid-off." The United Verde Extension Mining Co. has declared a quarterly dividend of 50c. per share, payable November 1, to stockholders of record at the close of business October 5. A statement to stockholders by the board of directors is as follows: Development work on the lower levels has been slow, but on the 1500-ft. level a notable increase of higher-grade ore has resulted. On the 1600-ft. level we have drifted in ore for 100 ft., but the indications for as large a body of ore as we have on the 1500-ft. level are not so good. The 1700-ft. development in favorable ground will be delayed until further work is done on the 1600-ft. level. In the upper levels of the mine development has been satisfactory. The following figures are from the financial statement:



KINGMAN OATMAN DISTRICT, ARIZONA

Cash on hand October 1, 1920	$1,069,442
Liberty bonds, par value $3,364,400, market	2,946,581
Copper on hand October 1, 1920, pounds	27,014,614

WICKENBURG.—The advertisement for sale at sacrifice prices, by a Los Angeles firm of the entire equipment of the famous Vulture mine at Wickenburg, recalls the fact that for many years this mine was one of the best producing gold properties in Arizona. It is reported that several million dollars worth of ore was removed from this property. The mine was shut-down about three

years ago and it was recently decided to sell the equipment while it was in good condition. This is said to be worth considerably over a quarter of a million dollars and to include modern equipment of all kinds.

Cave Creek.—The old Go John mine in the Cave Creek district, 30 miles north of Phoenix, is again shipping ore after years of inaction. Samples from the face of new workings show nearly 30 oz. silver, 0.5 oz. gold, and some copper. A long tunnel is being run to cut the vein from which the rich ore is being taken at a depth of 50 feet.

Oatman District.—A shoot of $24 ore is reported in the United American mine at Oatman. Following the recent discoveries in the Tom Reed, this strike is of particular interest to the Oatman district.

Globe.—The Old Dominion company has announced that four contests for prizes in first-aid work, open to all employees, will be held on or about December 1, 1920, February 1, April 1, and June 1, 1921. Three teams of six men each must take part in the contests, and the prizes will be in the form of a payment of $5 per month to each member of the winning team for the number of months remaining in the year from date of contest. The contests will be held under the auspices of the Globe-Miami Mine Rescue and First Aid Association.

Superior.—In a drilling contest held recently an American mine-drilling team won a victory over a Mexican team in a 15-minute contest, winning a prize of $1000. The winners drilled 36½ inches in the 15-minute period, as compared to 24¼ in. by the Mexicans. Dropping of a hammer, however, badly handicapped the latter team.

COLORADO

GAUSCHE PROCESS IN SUCCESSFUL OPERATION.—LESSEES AT LEADVILLE ARE ACTIVE.

Cripple Creek.—The new mill and concentrating plant of the Lincoln Mines & Reduction Co. on Ironclad hill, using the Gausche process, is in operation, and reported to be handling 100 tons of low-grade gold ore from the company's property daily. The initial run and clean-up will be of interest to local operators. Miners are steadily returning and operating forces are steadily getting back to normal.

October production, curtailed by the labor shortage in the first half of the month, totaled 35,256 tons with an average value of $12 per ton and gross bullion value of $425,298. The Golden Cycle mill at Colorado Springs reported the treatment of 16,000 tons of $19 ore and the Portland company's Independence mill handled 18,556 tons of $3.70 grade. The remaining 790 tons shipped direct to the smelter at Pueblo had an estimated value of $75 per ton.

Idaho Springs.—The holdings of the Argo Reduction & Ore Purchasing Co., including the old Gunnel mine and the Argo mill and tunnel, have been taken over by the Gem Mining Co. This company recently acquired the properties of the Idaho Mining, Tunnel & Transportation Co. which it is operating. The Gem stockholders are New York capitalists.

Durango.—The Co-operative Mining & Milling Co., owning and operating properties in the La Platas, has recently made the discovery of a four-foot vein of good silver-gold shipping ore. Lessees at the Idaho mine are reported mining $50 ore and have a shipment out; Mayday lessees are cleaning out No. 2 tunnel preparatory to development. Heavy snow has fallen.

Leadville.—Lessees of the Fanny Rawlins have opened a new body of zinc sulphate at the first level and have commenced production at the rate of one car per week. This ore is shipped to the Western Zinc Co.'s plant at Leadville. Sub-lessees on the third and fourth levels are mining and shipping silver ore averaging $50 per ton at the rate of 50 tons weekly to the A. V. smelter. The ore also carries some gold and copper. The Helen Gould mine in Tennessee gulch is producing low-grade gold-silver-copper ore. The mine is operated under lease. The National Mining Co., operating the Chicago in Iowa gulch, has cut minor veins in the course of development but is continuing its tunnel to a point 200 ft. ahead where a junction of veins is looked for, and where it is expected an orebody of good size will be found.

MICHIGAN

MOHAWK.—ARCADIAN CONSOLIDATED.—SENECA.

Calumet.—With some producing properties in the Lake district closed and others operating far below the rate of 1918, surplus metal stocks are steadily growing and the mines can do little else than mark time. With the recent drop in metal prices, the Lake mines are in a position not unlike that which prevailed at the beginning of 1919 when copper dropped from 26 to 14½c. per pound. Efforts have centred throughout the 'lean months' on a reduction in costs and there are hopes that the mines will be able to survive the dull condition of the metal market.

Ahmeek's production is holding close to that of September, with an average of 2750 tons of 'rock' daily. The October yield is estimated at about 1,600,000 lb. No. 2 shaft continues to be the biggest producer. The fissure-vein in this shaft still plays an important rôle and considerable 'mass' copper is coming from the fissure drifts. The openings are going westward on seven levels and, in the event mineralization continues, all of the drifts will reach the Kearsarge conglomerate, which is about 1250 ft. west of the Kearsarge amygdaloid. From time to time some of the drifts widen out to two feet, making the operations highly profitable. The fissure openings will permit the first extensive exploration of the conglomerate formation since it was opened by the old Ahmeek.

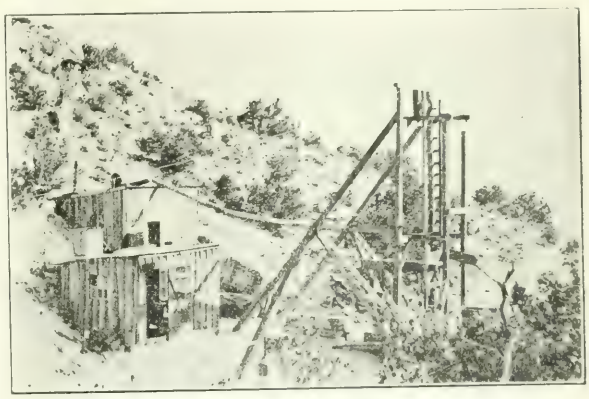
The Kearsarge lode on the 25th level of No. 4 shaft, Mohawk, has begun to widen and there are indications it again will reach the abnormal width of 35 or 40 ft. The continuation of this 'wide spot' is a decidedly favorable factor in Mohawk's life. In addition to increasing the yield per ton it is adding more years to its period of

productiveness. The same characteristics that were noted in the 22nd, 23rd, and 24th levels are visible in the 25th and it is believed the wide section will continue at least for 400 ft. just as it has in the levels immediately above. Operations continue in the levels between the 22nd and 24th, inclusive, and the ground is being removed as close to the hanging wall as possible, leaving only sufficient ground to ensure safety and prevent caving. The workings also are kept reasonably safe by the use of poor 'rock' from the upper levels for filling purposes. The yield of Mohawk varies from 23 to 24 lb., or slightly above the normal for the past six months, and 'mass' totals about 7% of the entire production in refined copper. Mohawk and Wolverine continue to mill their rock in the Mohawk plant and this arrangement will continue as long as the lull in the market holds out and the price of fuel and labor remains at present levels. Both mines will have a sufficient supply of coal until the re-opening of navigation in the spring, providing operations continue on the present basis of 60% of normal. The prevailing price of bituminous coal, $11 per ton delivered at the mine, makes it improbable that any of the Lake properties will lay in stocks to provide for a possible increase in the metal demand. Most of the companies, in fact, consider themselves fortunate to secure enough coal for the winter on the curtailed basis. Mohawk is constructing a number of stope-scrapers, modeled on the lines of one in service for 60 days. Mohawk also is building a level-scraper, patterned after its zinc-field model. Less steel will be used in its construction, however, making it possible to move it from level to level with greater facility.

Franklin's future course, so far as resumption of operations is concerned, will not be announced until December 1, though a decision was expected at the end of October. Pumps in No. 1 shaft will continue in commission so that the mine will be dry and ready to re-open on short notice. A small force of men has been kept at work since suspension, and the openings are in condition for immediate use, providing instructions to resume are forthcoming.

Arcadian Consolidated will cut the 7th level in its New Baltic shaft shortly and by the time the vein is opened by drifting a decision will have been reached as to winter plans. In the event the management decides to continue operations through the winter, the immediate objective will be the 9th level. At the rate the shaft has been sunk from the 4th, the 900-ft. station should be cut during late winter or early spring. The principal operation thereafter—the driving of a drift to connect with the Arcadian shaft—will be one of great importance to the property, for it will determine the extent southward of mineralization. Inasmuch as the showing in the Arcadian shaft is satisfactory there is hope for the extension of the rich ore opened in the Baltic shaft. This would ensure long levels of commercial 'rock' that could be tapped from both ends, making possible a large production.

In conection with the sharp rise in Seneca stock there have been rumors of the finding of a new lode. There is no confirmation. The only manner in which a new vein would be opened would be by cross-cutting, and for the past year or more, save for diamond-drill operations, Seneca's work has consisted entirely of developing the Kearsarge amygdaloid. Among reports that have been circulated is a story that the Douglass lode has been opened on Seneca property. Little credence is given this rumor, for the Douglass vein, which incidentally has been opened only on the old Arcadian property, is situated far to the east of the Kearsarge amygdaloid and nearer the zone explored by Mayflower. It is not impossible that the Douglass could be tapped by Seneca, at great depth. The showing in development work continues satisfactory.



FAGAN CONSOLIDATED MINE, SIMON DISTRICT, NEVADA

NEVADA

J. H. FARRELL REPORTS ON THE DIVIDE MINE.—ORE-RESERVES ARE $1,500,000 WITH ONLY FAIR PROSPECTS FOR FUTURE DEVELOPMENT.

DIVIDE.—In his report submitted July 1, 1919, A. I. D'Arcy, then consulting engineer to the Tonopah Divide company, said that "as a matter of speculation," figuring silver at $1 per ounce, the mine "could be expected to produce $9,108,000 gross from the present workings." On December 31, 1919, E. A. Julian, then consulting engineer, made a report that was not made public until nearly four months later. Julian, figuring silver at $1.25 per ounce, estimated the gross value of the ore at $1,385,000. Now J. H. Farrell, reported to have examined the mine for the Hayden-Stone-Jackling interests, says in his report that the "assured and probable ore" is worth $1,558,733, figuring silver at $1 per ounce. "New ore opened in recent development work is, of course, only partly blocked-out, but liberal allowance has been made, both as to continuity of shoots and average value of the ore", the report says. The D'Arcy report was optimistic

as to the future of the mine, the Julian report was less so, and the Farrell report is still less so. D'Arcy said: "The appearance and size of the vein surely indicate that the orebodies will persist to great depth", whereas Farrel says: "Oxidation, kaolinization, and leaching have extended from the surface to the 1000-ft. level, but primary sulphides have been left in most of the ore-shoots as close to the surface as the 165-ft. level. When the water-level is as deep as it is here it is often not well-defined and does not produce a distinct zone of enrichment. Under such circumstances, while metals are re-distributed to a considerable extent, they are not necessarily concentrated. Another consideration is that an important part of the original silver content of the upper vein-zone has been stabilized as the relatively insoluble silver chloride." However, he says: "There is always the mining chance that the rather weak primary mineralization of the upper levels may, as its source is approached, give place to a much more important occurrence of ore minerals, and this chance is worth investigating, not only on the 1000-ft. level, but possibly at greater depth, though this will depend largely on the condition on this level." He considers that "good ore occurring at or near the water-level, due to metals leached from the upper or oxidized zone", is a "possibility". But, he says: "Owing to the rather erratic character of the fractures and the fact that they developed into clay seams rather than open fissures, the primary mineralization probably was correspondingly spotty or erratic, as was also the concentration due to downward-leaching surficial waters. It is accordingly impossible to determine with any certainty whether the apparent weakness of the primary stage is due to structural conditions unfavorable to ore deposition or to a brief and inffectual period of mineralization. The bulk of the evidence rather favors the latter hypothesis. This point is important; otherwise the deposits might be expected to become more extensive with depth and more concentrated, especially if a favorable formation underlies the Divide breccia." Farrell makes several statements regarding the possibility of secondary enrichment and in the most definite he says in referring to a report made by George H. Garrey: "The writer has read this report and has derived much valuable information from it, though, differing with Mr. Garrey, he believes that secondary enrichment will be of minor importance." Two ore-shoots have been mined for widths of 8 to 30 and lengths of 50 to 75 ft., according to the report. "The more important parts of these shoots are above the fourth level. The orebodies occur at intersections of cross-fractures with the main vein-zone and other smaller shoots doubtless will be found within the developed parts of the vein. It is thought that important additions to the ore-reserves will be made by prospecting now being done above the 165-ft., or first level. The showing on the fourth and fifth levels is rather disappointing, but there are still some development chances to be tried." D'Arcy reported of the fourth level that the south-east drift, for 110 ft., "sampled across the width of the drift at 5-ft. intervals, give average assay values of $148 per ton." The report is regarded as definitely settling the uncertainty that followed the issuance of the Julian report, which it checks closely as to ore-reserves. Noting the work being done on the 800 and 1000-ft. levels, Farrell says: "The early results of this work may not fulfill expectations, but there is a chance of finding by consistent development orebodies similar to those of the upper levels, but possibly not of such high grade, as the upper ores are formed by silver-chloride enrichment. However, the prospecting chance on the 1000-ft. level, as well as below water-level, is one that should be thoroughly tried out." Practically all of the ore in the mine is in the rhyolite breccia and the report points to the possibility of finding gold ore in the rhyolite. Farrell says of this: "Earlier mining operations proved the existence of several small veins in the rhyolite and later work in the same formation has suggested the possibility of extensive low-grade deposits. The possibility is worthy of detailed investigation."

Goodsprings.—The Christmas Consolidated is to spend $4000 in development of the seven vanadium claims owned by the company. Another $1000 will be spent in building roads and sinking a shaft a short distance to find water. Little work has been done on the claims.

West Divide.—Zeb Kendall has completed payments on the McCoy and Cook stock in the West Divide that he held under option. A cross-cut has been driven to the vein 25 ft. below the tunnel-level and 3½ to 4 ft. of "rich ore" has been found, according to L. L. Patrick, manager.

Battle Mountain.—The 400-ft. shaft of the Betty O'Neal, an old silver producer at Lewis, 12 miles south of here, has been unwatered and the first mining since 1883 has been started, with 20 men employed. The water had been at the 250-ft. level for 38 years, but the shaft-timbers were found in good condition. It is said that several good widths of ore have been found and Noble Getchell, general manager, whose father worked the mine until 1883, plans to build a mill in the spring.

Mina.—It is reported that engineers of the Dome Mines, Ltd., have been retained to supervise the construction of the reduction plant of the Simon Silver-Lead Co. and are now at the property. The capacity of the initial unit is to be 150 tons per 24 hours, constructed so that additional units may be added. The milling ore developed in the mine to date together with the additional tonnage exposed as development work is carried forward on the lower levels is sufficient to keep the mill in operation for several years.

Piochе.—John R. Cook, manager for the Mascot Silver Mining Co., which owns the Yuba East mine, near here, is at Salt Lake City making arrangements for the early resumption of work at the property. A large tonnage of milling ore is available for treatment. About two years ago several cars of high grade silver lead ore were shipped from the property, since which time it has been idle. The Salt Lake Route has taken no action as yet regarding a reduction in freight-rates on shipments of ore from this district. During the week ending October 30, the

Prince Consolidated shipped 1750 tons; Virginia-Louise, 650; Consolidated Nevada-Utah, 200; Bristol Silver Mines, 160; Black Metals, 105; Bristol-Battles lease, 45; Campbell lease, 45; total, 2955 tons.

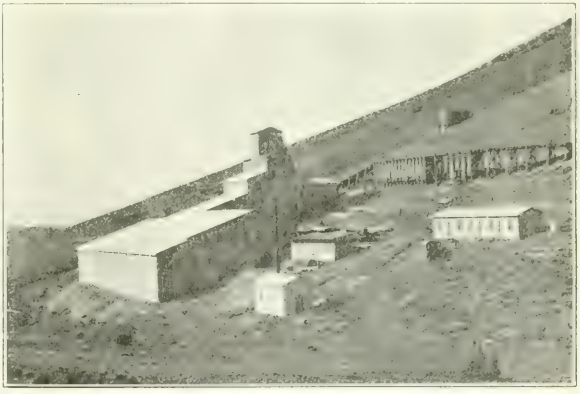
UTAH

BRONZE TABLET FOR UTAH COPPER EX-SERVICE MEN. REPORT OF PROGRESS AT TINTIC STANDARD MINE.

SALT LAKE CITY. On November 3 a magnificient bronze tablet, the gift of the Utah Copper Co. and the Bingham & Garfield Railway Co., was dedicated in the office of R. C. Gemmell, general manager, in the presence of the Salt Lake City office employees of the two companies. The dedication address was by Reverend Elmer I. Goshen. The tablet bears the inscription at the top "This tablet is Dedicated in Honor of Those Employees Who Answered the Call of Our Country and Enrolled for Service, 1917-1918" followed by the names of the employees. About 775 employees of the two companies entered Government service during the world war, 17 of whom made the supreme sacrifice.

The Grasselli Chemical Co., which has been in the zinc-ore purchasing business in this State for twenty years, has decided to close its offices in this city. George H. Short, local manager, states that this action has been taken on account of the increase in freight-rates, as well as the unsatisfactory market conditions. The hearing before representatives of the Interstate Commerce Commission regarding increases in intrastate freight-rates on ore and coal was begun on November 1. Walter Fitch, president of the Chief Consolidated Mining Co., the largest shipper in the Tintic district and one of the leading silver producers in the United States, introduced exhibits to show the high earning power of the railroads on existing rates on ores. He stated that they must be the source of substantial profit to the railroads, and characterized the plea of the carriers as "a blind business proposition". Jackson McChrystal, representing the Gemini, Godiva, Ridge & Valley, and Eureka Mines companies, introduced testimony to show the effect the proposed increase in rates would have on the properties he represented. A. G. Mackenzie, secretary of the Utah Chapter of the American Mining Congress, and H. W. Prickett, of the Traffic Service Bureau, gave their views on the proposed increases, and expressed the opinion that many of the low-grade metal and coal mines of the State would be compelled to suspend operations.

BINGHAM.—The contract labor system at the Utah-Apex property, under which miners and other laborers are paid according to the amount of work accomplished, is resulting in an increased efficiency of 50% over the wage-scale system. Sinking of the four-compartment shaft from the 2000-ft. level to the 2400 is proceeding satisfactorily, although somewhat handicapped by shortage of labor. It is expected that an extension of the rich orebody cut on the 2000-ft. level will be opened at this depth. On the 1300 and 1400-ft. levels, where the downward extension of the Parvenu orebody—one of the richest deposits in the property—has been found, conditions are interesting. About 300 tons of ore per day is being treated in the mill, where an oil-flotation unit was recently installed with excellent results. From 200 to 300 tons per day of straight smelting ore is also being produced. When the condition of the market for lead warrants, production can be substantially increased. No action has been taken as yet by the Utah Consolidated Mining Co. to appeal the decision of Judge Johnson in the recent litigation to the Circuit Court of Appeals. Within 30 days after the official entry of the decree, the Utah Consolidated must file with the court a statement of all ore extracted from ground now held to belong to the Utah-Apex Co. The latter then has the right to take exceptions to the findings. Since the court's decision, the Utah Consolidated has ceased mining in the workings wherein it was found to be trespassing.



THE ROCHESTER MILL, AT ROCHESTER, NEVADA

A special meeting of the stockholders of the Bingham Mines Co. was held at the head office of the company in Portland, Maine, on November 10, to vote on recommendations of directors that the company purchase 50,000 shares of its stock at $10 per share and hold same as unissued capital stock, thereby reducing the outstanding capital from $1,500,000 to $1,000,000.

EUREKA.—The directors of the North Standard Mining Co. have levied an assessment of one cent per share on the outstanding stock. The levy was delinquent November 2 and the sales-date is November 22. Shipments of ore from this district for the week ending October 30 dropped back to the normal output, totaling 129 cars, of which the Chief Consolidated shipped 35; Tintic Standard, 34; Dragon, 12; Mammoth, 11; Eagle & Blue Bell, 7; Iron King, 6; Grand Central, 6; Victoria, 4; Swansea, 3; Iron Blossom, 3; Sunbeam, 3; Bullion-Beck, 2; Ridge & Valley, 1; Gold Chain, 1; Alaska, 1. The power-line to the South Standard property has been completed and the

transformers installed. It is stated that the shaft at this property will be sunk to a depth of several hundred feet during the winter. Work has been suspended at the Copper Leaf property, in the eastern part of the district. During the past few years, considerable exploration work has been done by this company in the hope of finding an extension of the Tintic Standard orebody. A deep working shaft was sunk and extensive drifting has been done on two levels. Many small bunches of ore were found but no large deposits. The property is well equipped, amply financed, and it is not expected that it will remain inactive for any considerable period.

During the month of October, the Tintic Standard Mining Co. shipped 150 carloads of ore, containing 50 to 55 tons per car, which netted the company from $25 to $30 per ton, or a total net profit of approximately $200,000. Shipments could be increased if the railway company could supply additional cars. The present production is coming from the 1100, 1250, and 1350-ft. levels. The reserves of mill-ore are estimated at between 700,000 and 800,000 tons, with additional tonnage being developed all the time. More miners have been secured and the employees as a whole are rendering more efficient service, according to E. J. Raddatz, president. The area in which operations are being conducted constitutes about 600 or 700 ft. on the strike of the mineralized zone, which runs through the property for a distance of nearly three miles. Mr. Raddatz believes it will take five years to open the mine to permit maximum production.

PARK CITY.—One of the most important pieces of development work now under way is the driving of a drift from the 600-ft. level of the Ontario to prospect at depth the Naildriver property. This drift will enter the latter property at a depth of 2300 ft., or 400 ft. below the deepest workings at present, and will also serve to prospect virgin territory of the Ontario. The Judge Mining & Smelting Co. is retaining its technical staff at the zinc smelter, which was closed on October 22, for the purpose of conducting experiments and to have the plant in condition for resumption of operations when conditions warrant. Practically all of the workmen at the smelter have been given employment in the mines of the district.

BRITISH COLUMBIA

ENGINEER MINE INVOLVED IN LEGAL CONTROVERSY. PLATINUM IN TULAMEEN RIVER COUNTRY.

VANCOUVER. The Federal government has instructed the Royal Canadian Mounted Police to turn back prospectors going to Fort Norman, at the junction of the Great Bear and Mackenzie rivers, unless they are completely equipped to withstand the rigors of the northern winter. This order is similar to one in effect during the rush to the Yukon, when gold was first discovered, and, like that one, has been issued purely to prevent useless loss of life and privation among unequipped people rushing to the northern regions to stake claims. A number of properly equipped parties have arranged to make the trip within the next few weeks. By a decision recently handed down by the Supreme Court, Chief Justice Hunter has dismissed the action of Stewart et al v. the Molybdenum Mining & Reduction Co., Ltd. The case has been dragging through the courts for some time. It involved the title to the Conundrum claim, at Alice Arm, on which both silver and molybdenum have been developed in commercial quantities. The amendment to the Semi-monthly Payment of Wages Act, passed at the last session of the local legislutare and providing for 26 paydays annually, each falling on a Saturday, has become effective. The new law affects the coal mines, but not the lumber and fishing industries, to which the original act also applied.

The suits predicted with reference to the Engineer mine, at Atlin, one of the best known gold properties in the Province, are before the courts. W. L. Goodwin and eleven other prospectors have taken out a *lis pendens* to prevent the sale of the property until their claims can be brought before a grand jury. It is suggested that a sale for $3,000,000 to Cobalt interests is in negotiation. Mr. Goodwin and his associates assert that they, and not the estate of the late Captain Alexander, are the lawful owners of the mine. Twenty years ago, it is declared, they staked the claims now known as the Engineer group and Capt. Alexander, it is alleged, staked over them, altering the lines and making the eleven claims which afterward were known as the Engineer claims. It is claimed that their property was fraudently 'jumped' and recorded, and that crown grants were wrongfully issued to the Alexander party. The second action against the Alexander estate is brought by W. Pollard Grant, of Vancouver, who claims a one-fifth interest in the mine and affirms that documents in his possession will prove that Capt. Alexander was his trustee for the one-fifth interest in the mine.

The Canadian Advisory Council for Scientific and Industrial Research has made an appropriation to finance experiments in the treatment of the silver-lead-zinc ores of British Columbia. Horace Freeman, chemical and metallurgical engineer, and secretary of the British Columbia branch of the Council, states that the grant is sufficient to cover the first twelve months work. Mr. Freeman will begin his research immediately and is hopeful of finding an economic method for the handling of the complex sulphide ores. Mr. Freeman is responsible for a formula, now in use at Niagara Falls, for the making of cyanide from atmospheric nitrogen. The product is in use in gold and silver milling plants in the United States and Canada.

HAZELTON.—J. D. Galloway, resident mining engineer for the district, recently visited the Babine Bonanza, and reports an excellent showing of ore where the tunnel cut the orebody. Several directors from Spokane also visited the property, and as a result of their visit it has been decided to use hand-steel to drift on the lode rather than wait for the erection of machinery. This change of plan has been reached because of the bad state of the roads, after the continuous rains. They are in places little bet-

ter than quagmires, and the passage of heavy machinery over them is impossible.

ARROW LAKES.—The Millie Mack mine, near Burton, has 50 tons of high-grade awaiting the raw-hiding season to get it to the road. The Millie Mack was located more than 20 years ago by George McDonnald. It has changed hands several times, and at present is owned and operated by H. E. Foster. The ore carries both gold and silver, the latter predominating.

GRAND FORKS.—The diamond-drilling at the Franklin Camp, which was being done under the supervision of Philip B. Freeland for the Provincial government, has been stopped for the season, the contractor realizing that he could not continue operation profitably through the winter. A total of 2888 ft. has been drilled during the season, most of the work having been done on the Gloucester claim.

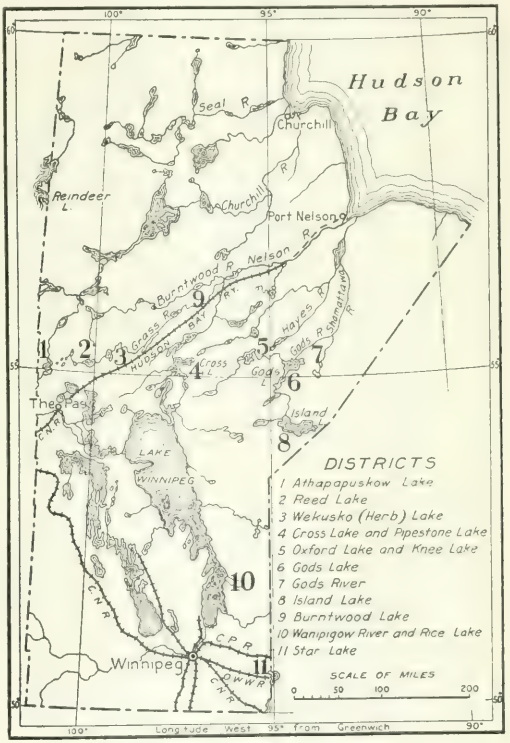
PRINCETON.—H. R. Van Wagenen, general manager for the Canada Copper Corporation, recently made the following announcement with regard to the starting of operations at Copper Mountain and at Allenby: "Only the first 1000-ton unit is in operation, nor is it as yet up to capacity, but the tonnage treated is constantly being increased. The recovery at the mill has been satisfactory right from the beginning. Power from the West Kootenay Power Co. was made available at the mine on October 17; the first train of 10 cars over the Copper Mountain branch of the Kettle Valley railway was moved from the mine to the mill on October 19."

That a vein of platinum, 4 in. wide and 30 ft. long, in a 7-ft. lode of serpentine rock, exists near the headwaters of the Tulameen river, is the assertion of Robert Stevenson, a pioneer prospector, who is one of the few still living who took part in the gold stampede of the '60's into the Cariboo. This find was made, Mr. Stevenson states, in 1877 and ever since he has kept the claim alive. With platinum at 50c. per ounce he did not pay special attention to the development of the property. He has taken a force of men with him to open the vein, which he expects to be profitable with platinum selling at $100 per ounce.

MANITOBA

THE FLIN FLON PROPERTY.—RICE LAKE DISTRICT.

THE PAS.—Five years ago four prospectors discovered indications of copper at a point some 60 miles northwest of The Pas and staked numerous claims. Today this deposit is known at the Flin Flon and 16,000,000 tons of a mixed sulphide ore, valued at $9.50 per ton, has been proved above a depth of 900 ft. The property is at present under option to New York and Toronto capitalists, the price being given at $3,000,000. Diamond-drill holes were put down 900 ft., at which depth the ore-body was showing no sign of becoming leaner. Now, this last summer, a large force of workmen has been busy sinking shafts and drifting. Two shafts, 400 ft. apart, have been sunk 200 ft., and are being connected by a drift, which should be completed by January. At present 150 men are employed, although the force would have been larger had laborers been obtainable. The Flin Flon property is on the border line of the Province, in fact several of the claims are in Saskatchewan, and to reach it a railway 85 miles long must be built. This the Federal and Provincial governments seem inclined to do, providing guarantees are given by those operating the property that a certain tonnage will be smelted. It is estimated that to develop the property to a producing point, build the smelter, and harness the water-power now running to waste on the Sturgeon river will cost not less



PART OF MANITOBA

than $5,000,000. The ore is a mixture of copper, iron, and zinc sulphides, containing some gold.

It is reported that the Bingo Mines company has completed the sinking of its shaft to the 50-ft. level. Another contract has been let to continue the shaft to 200 ft. and also to cross-cut at the 100-ft. level. The object of the cruss-cutting is to determine the value of the four veins which appear on the surface, all of which are within 60 ft. of the main vein. Sampling in the shaft gives returns ranging from $23.60 to more than $100.

RICE LAKE.—This district, which lies on the east side of Lake Winnipeg and within 100 miles of the city of Winnipeg, is passing through a crisis. The public has lost interest in the field, owing to the reputation it earned for being more renowned for samples than for steady production, but it is probable that better times are in

store for it. Many competent judges believe that there is more than one property that would make a mine if given a fair chance. Unfortunately the number of experienced prospectors is small, snow-stakings many, and capital scarce. Many heard with regret that the Gabriel had proved disappointing under the careful sampling of J. B. Tyrrell; but the directors would probably have a following in subsequent work, as it is recognized they acted for the best interests of all concerned when they decided to suspend operations and accept personal losses.

ONTARIO

MINERS ARRIVE FROM CORNWALL. PATENTED CLAIMS ARE FORFEITED FOR DELINQUENT TAXES.

COBALT.—Cornish miners are beginning to arrive in Northern Ontario, seeking employment in the gold and silver mines. They have been imported on account of a shortage of labor, and have been assured steady employment at wages above the rate in England. Close to two hundred have already crossed the Atlantic, and more will follow. An exceptionally dry season has caused low water in the rivers and has left the mines short of hydro-electric power. As a consequence, the silver mines of Cobalt were obliged to work at considerably reduced capacity during the last half of October. Fall rains are now starting and the next few weeks is expected to bring relief. The Ontario Department of Mines passed an Order-in-Council on October 13 declaring all patented mining claims forfeited and open for re-staking, on and after noon of October 28, on which the owners have failed to pay a certain Provincial mining tax of five cents per acre. Various property owners, including the Teck-Hughes, Hudson-Kirkland, and Ontario Solid Silver mines appear to have been unaware of such a tax and were included in the list of delinquents. By special Orders-in-Council the Government has since recalled these properties from forfeiture, but has not taken action in regard to scores of others forfeited for similar reason. In the meantime, many such properties to which former owners are carrying deeds have been re-staked. The situation has caused a sensation in Ontario mining circles. A general request for re-instatement is being made.

On October 31, the Coniagas Mines closed a successful fiscal year. Net earnings exceeded half a million dollars. The annual statement is being prepared and will be issued in December. Ore developed on the Keeley Silver Mines since work was resumed early this year is estimated to contain 400,000 oz. of silver. The newly installed 20-stamp mill is now in operation. The Chambers-Ferland has made arrangements to explore part of its property through a shaft on the Right of Way Mines Co. Cross-cutting is under way at a depth of 385 ft., and it is planned to explore thoroughly that part of the property lying between the Nipissing and the La Rose. Fire recently destroyed the first shaft-house to be constructed in Cobalt, on the La Rose property. The miners were removed without injury or loss through another shaft, but operations were delayed some days on account of damage done to machinery and equipment.

PORCUPINE.—The Dome Mines, for the five months ended August 31, reports a surplus after charges and taxes of $198,467, equivalent to 49c. per share on its capital stock of $4,000,000. The report that the Dome had purchased 26 additional machines for underground work to be ready for an influx of mine-workers from England is officially confirmed.

At the annual meeting of the shareholders of the North Davidson the financial statement submitted showed that $73,256 had been expended in development. R. T. Jeffrey, president, stated that the results from diamond-drilling were beyond expectations, assay from three drill-holes giving an average gold content of about $25 per ton. A 4-ft vein, stated to be very rich, has been cut at a depth of 52 ft. in the shaft.

KIRKLAND LAKE.—The Lake Shore during September produced $40,150 from the treatment of 1480 tons of ore, the average recovery being $27.12 per ton. Sinking was done to the extent of 54 ft. The Ontario-Kirkland has decided to delay the construction of its mill until spring in the expectation of lower prices for material. At the Kirkland Lake the 900-ft. level, the deepest in the camp, is being opened. The mill is treating 125 tons of ore per day. A drift started on the 400-ft. level has been halted owing to labor shortage.

MEXICO

GOVERNMENT TO BUILD ROADS.

SONORA.—It is reported that the Government will aid mining interests of Sonora. The first help to be extended will be received by the Puertocito mine, situated south of Naco and Cananea. This mine is being operated under serious difficulties for the reason that the road leading from the camp to highways running into Cananea, Naco, and Agua Prieta are practically impassable. In addition the road, which is really a trail, is dangerous to travel. Engineers sent into the district reported that it was possible to construct a good road, and plans for such a highway have been forwarded to Mexico City. It is understood that a sum of $20,000 has been made immediately available in order to make the roads passable.

CHIHUAHUA.—Announcement is made that the Bernice mining company expects to begin shipments of high-grade silver-lead ore from its properties in Mexico to the smelter at El Paso. The properties are situated near Comidor, within a mile of the Rio Grande, in the State of Chihuahua, and about 30 miles south-west of Valentine, Texas.

Robert Rae, formerly chief auditor for the Phelps Dodge Corporation at Douglas, Arizona, has recently returned from a visit of several weeks to the State of Chihuahua. He reports industry to be reviving and peaceful conditions everywhere. The American Smelting & Refining Co. is active in getting its properties back into operation, and the same can be said of the Alvarado Mining Co. of Parral. The opinion prevails that within the present year many important mining operations in the State of Chihuahua will return to normal.

THE MINING SUMMARY

ALASKA

Juneau.—A property which gives promise of developing into an important producer of gold now is being opened up on Chichagoff island. Work is being continued throughout the winter by the Falcon Mining Co. A tunnel has been driven for 220 ft. and it is said that the showings are so encouraging that the owners plan to commence shipping in a short time.

CALIFORNIA

Amador County.—The Central Eureka company has increased mine development and will shortly start another unit of the mill. Excellent ore continues to be drawn from the 3900-ft., with the orebody on that level developing well. ——With the pumping plants in the Argonaut and Kennedy shafts operating with a full head, unwatering of the Argonaut workings is making rapid progress. Withdrawal of restrictions regulating use of electric power has materially aided rapid clearance of the shaft. The workings have been found in good condition as the water is lowered and comparatively little repair work will be necessary before actual mining is resumed.

Plumas County.—The high cost of power, coupled with high wages and freight-rates and the declining price of copper, are reasons assigned by the Walker Copper Co. for laying-off the majority of its miners and suspending copper production. Only a sufficient number of the crew is to be retained to maintain development and construction work. The mine has been employing 170 men.——The Gruss Copper Co. reports the intersection of the main east-west vein on the 200-ft. level. The discovery was made 350 ft. north of the shaft and a large body of rich ore is said to be exposed. A raise is advancing on the vein to connect with the old Kalfus workings. Plans are under consideration for erection of a mill with a capacity of 200 tons of ore per day.——The Engels Copper Co. is preparing to increase development work, despite the unfavorable copper market, in order that the company may be in a position to take full advantage of more favorable conditions. At present 450 men are employed with development of new territory receiving prime attention. The flotation-plant is running steadily.

Redding.—The work of tearing down the Balaklala Copper Co.'s smelter at Coram has been completed and most of the structural steel has been delivered at Bully Hill, or Winthrop, where it will be used in erecting works for the Shasta Zinc & Copper Co. The foundations for the Bully Hill buildings are complete.

COLORADO

Breckenridge.—Contrary to a recent report the Tonopah Placers Co. has not ceased operations in this district.

Silver Plume.—Donald H. Fairchild has completed an examination of the Dives, Pelican, and Seven-Thirty mines and a series of mill-tests on ore collected from the mine dumps. The Wasatch-Colorado mill was used for the test-run while the jig and table tailings were taken to Denver for further tests by flotation. A net recovery of 94% of the silver was obtained. It is probable that the present mill will be remodeled and operation of the mines resumed.

IDAHO

Coeur d'Alene.—Frank Murphy, of Spokane, has received $100,000 for two claims which the Coeur d'Alene syndicate has purchased in acquiring the Flynn claims. In addition he retains 50,000 shares of stock in the Senator Mining Co., the property which was included in the purchase. This is one of the first cash payments in this transaction, which is one of the most important in many years in the district.—— Good ore has been found in the Nevada-Stewart property adjoining the Highland-Surprise on Pine creek. Seven feet of vein is filled with stringers of lead-zinc ore and in one place there is one foot of almost clean ore.

H. W. Steadman, manager of the Paragon mine, states that he is working two small forces, one on the Black Horse property and the other on the Chicago. "Good ore is being uncovered, especially in the Chicago," said Mr. Steadman. "The zinc in the ore is being replaced by galena. The ore is improving, which indicates we may have large orebodies with depth. The company intends to continue its shaft 400 ft. which will give a depth of almost 900 ft. on the vein." ——Ore from Alaska is coming to the smelter at Kellogg, but until freight-rates are adjusted no great tonnage is expected from outside of the Coeur d'Alene district, according to F. W. Bradley, president of the Bunker Hill & Sullivan company.

"We must find one," was his reply when asked if the Bunker Hill & Sullivan company will find a method of treatment of the zinc-lead ores of the Coeur d'Alene. "It is most important to the district that such a solution be found and we are continually carrying on experiments. We will find it if possible."——Work at the American Commander mine is progressing. The company is fixing up winter quarters for its men and will resume development work. It is reported that a vein 10 ft. wide, containing considerable galena, was found in cross-cutting from the bottom of the shaft.

Wallace.—C. W. Newton, manager for the Consolidated Interstate-Callahan Co. confirms the report that his property will suspend operations early in November. This will result in the discharge of about 350 men employed in the mine and mill. During the suspension of shipments, underground development will be carried on, but Mr. Newton was unable to say how many men will be retained for this work. It is stated that the principal reason for the suspension of operations is due to a strike of the smelter employees of the Grasselli Chemical Co., which strike was begun in September. The October production of ore was the largest in any recent month. No statement has been made as to the probable length of the period of inactivity.

MISSOURI

Joplin.—The shut-down that had been in effect throughout the district for two weeks ended the first of November and a number of mines resumed operations the following morning. A number of other mines that observed the shut-down started several days later. The managers were of the opinion that it would be better to wait two days longer and start work with a complete force than to try to operate with an insufficient number of men. The continued curtailment of ore production will be carried out as effectively as possible. The demands on the district are for about 7000 tons

per week and production will be held to this amount if possible. Operators are agreed that further curtailment is necessary and are showing a spirit of co-operation that is encouraging, as it is felt that in this way only can the best interests of the industry be served.——The Richardson mines, at Quapaw, have started and will run on two shifts. The company has been reorganized since the mill shut-down several months ago, and now is under the direction of a strong company composed of Texas and Oklahoma men. The mill has a capacity of 500 tons in 20 hours, and the endeavor will be to run at full capacity. An assay shows 5.41% lead and 13.06% 'jack', secured from an 18-ft. face of ore. An electric pump has been installed and will have capacity sufficient to handle the heavy flow of water. The mill will be run with a modern gas engine, while the hoist is operated by steam. W. E. Sheatham is the superintendent in charge. ——The new shaft being sunk at the Vantage mine in Picher is down about 125 ft. and will be continued as rapidly as possible until the orebody is reached. The shaft is on Netta street, near the edge of the lease adjoining the St. Joe property. As soon as the shaft is ready for operation a dummy line will be built to the mill at Third and Treece streets. The mill has undergone extensive repair in the last few weeks.——The Dorothy Bill mine is working on ore obtained from a new shaft recently sunk north-east of the mill. The ore is rich in both lead and zinc and is expected to prove one of the richest lead producers in the district. The ore is being transported to the tramway in cars pulled by mules.

NEVADA

Eureka.—During the past two weeks 33 cars of ore and speiss have been shipped out over the Eureka-Nevada railway, consigned to the Utah smelters, for treatment.——At Ruby Hill, the water in the Locan shaft has been giving less trouble, only 600 gallons per minute being made. It has been held down to the 1200-ft. level, where a station is being cut. A second station-pump will be installed. Ore is being blocked out on the Locan 900-ft. level.——At the Eureka-Croesus mine the No. 8 winze is down 50 ft., the last 27 ft. being in good shipping ore. The 'shale' winze is yielding ore of good quality, and some of the old workings of the Dunderberg mine are producing a little good shipping ore.

The Holly mine is a steady producer of good shipping ore. The drift from the shaft, at a depth of 430 ft., broke into the Williamsburgh workings about 10 days ago, and a track has been laid from the point of connection to the Bullwhacker ground. A connection is thus established with the Holly shaft at the 500-ft. level, which admits of the removal of Bullwhacker ore through that thoroughfare.——Four carloads of materials for the construction of the Holly milling plant arrived a few days ago.——Eureka appears dull at present to the casual observer, but there is more prospecting under way in the Prospect Mountain and other outlying small mines than was ever before known in the district. All of the old-time miners in the district are impressed with the belief that ore will be found either in the Locan shaft, at an additional depth of 500 ft., or by drifting therefrom. There is reason, from a geological standpoint, to believe that ore will be found in the lower Ruby Hill wedge of brecciated limestone.

YUKON TERRITORY

Dawson.—With reference to the Mayo Silver camp, some 200 miles from here, Alfred Thompson, M. P. for the district, states that he will ask the Dominion government to build a road to the district, provide either wireless or telegraphic communication, and build an assay-office. He anticipates that the development of the silver deposits will bring the Yukon into prominence again as a mining centre and will assure Dawson a permanence which the placer industry has failed to do

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

J. M. Callow is in New York.

Maurice W. Summerhayes is in San Francisco.

William Burns is going to the copper mines of Michigan.

Walter Fitch Jr., mining contractor of Eureka, Utah, is in Alaska.

Errol MacBoyle, of San Francisco, is examining mines in Mexico.

Donald M. Liddell has moved his office to 2 Rector street, New York.

E. B. Lighthill has closed his office in London and is now established in Paris.

F. W. Collins expects to return to Oakland from Peru in time for Thanksgiving.

Spencer C. Browne has opened an office as consulting engineer at 2 Rector street, New York.

A. H. Jones is in New York, in consultation regarding the erection of a large mill in New Mexico.

Donald H. Fairchild has been examining the old Pelican and Dives mines at Silver Plume, Colorado.

W. J. Loring and **John F. Davis** are attending the meeting of the American Mining Congress at Denver next week.

Norman C. Stines was in San Francisco this week on his return from Nome. He is now on his way to New York.

George Kingdon, general manager for the United Verde Extension Mining Co., has recently returned from a trip to Europe.

H. B. Tooker, traffic manager of the Jackling interests, has returned to San Francisco after a trip to New York and Washington.

H. V. Burgard, secretary of the Mineral Metal & By-Products Co., of Denver, has returned to Denver from the Pacific Coast.

Edward H. Benjamin has moved his office from the Nevada Bank building to the Balboa building, at 593 Market street, San Francisco.

Frank T. Eddingfield has been appointed Valuation Engineer in the Metals Division of the Income Tax Unit, Internal Revenue Bureau.

O. C. Ralston, of the U. S. Bureau of Mines, has returned from Alaska, where he inspected the practicability of the establishment of a smelter.

R. D. Maxfield and **E. M. Tripp**, of Salt Lake City, are making an investigation of a placer-mining property in White Pine county, Nevada.

J. Fred Johnson, superintendent of the Chief Con. Mining Co. at Eureka, Utah, has been making an examination of a gold property in California.

L. D. Jenssen, superintendent of the Lokken iron mines in Norway, is visiting mining districts in this country, and spent several days in Utah.

Alan M. Bateman, mining geologist, has been engaged in professional work in Alaska and British Columbia, and has returned to New Haven, Connecticut.

Charles Butters and **H. N. Lawrie** addressed the New York section of the Institute on November 3, the first on the subject of silver, the second on the gold problem.

J. O. Lewis, chief petroleum technologist of the Bureau of Mines, has tendered his resignation to Dr. F. G. Cottrell, Director, to become effective November 15. Mr. Lewis will be succeeded by **A. W. Ambrose**, who has for some time occupied the position of superintendent of the Bureau of Mines petroleum experiment station at Bartlesville, Oklahoma.

THE METAL MARKET

METAL PRICES

San Francisco, November 9

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	16.50—17.00
Lead, pig, cents per pound	7.50—8.50
Platinum, pure, per ounce	$95
Platinum, 10% iridium, per ounce	$135
Quicksilver, per flask of 75 lb	$55
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

November 8.—Copper is quiet and firmer. Lead is dull but easy. Zinc is inactive but steady.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Nov. 2 Holiday			Sept. 27	93.52	59.66
" 3	82.12	53.75	Oct. 4	91.65	58.98
" 4	82.62	54.12	" 11	86.77	55.66
" 5	82.00	53.87	" 18	83.10	54.05
" 6	82.00	54.37	" 25	79.52	52.31
" 7 Sunday			Nov. 1	80.31	52.35
" 8	80.75	53.87	" 8	81.90	54.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	93.66
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	83.48
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound

Date		Average week ending	
Nov. 2 Holiday		Sept. 27	18.70
" 3	15.00	Oct. 4	18.50
" 4	15.00	" 11	17.85
" 5	15.00	" 18	17.15
" 6	15.00	" 25	15.75
" 7 Sunday		Nov. 1	15.08
" 8	15.00	" 8	15.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	18.75
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	16.53
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Nov. 2 Holiday		Sept. 27	7.85
" 3	6.90	Oct. 4	7.54
" 4	6.75	" 11	7.50
" 5	6.85	" 18	7.50
" 6	6.85	" 25	7.08
" 7 Sunday		Nov. 1	6.92
" 8	6.85	" 8	6.84

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	8.08
Apr	6.99	5.05	8.78	Oct.	8.05	6.40	7.28
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	44.43
Apr	88.53	72.50	62.12	Oct.	78.82	54.82	40.47
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Nov. 2 Holiday		Sept. 27	7.73
" 3	7.35	Oct. 4	7.66
" 4	7.30	" 11	7.55
" 5	7.30	" 18	7.41
" 6	7.30	" 25	7.50
" 7 Sunday		Nov. 1	7.54
" 8	7.30	" 8	7.31

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	7.84
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	7.50
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Oct. 26	65.00
Oct. 11	75.00	Nov. 1	60.00
" 19	70.00	" 9	55.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.50	75.00
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

RAILROAD FINANCING

Now that the Transportation Act, giving the Commerce Commission control over issuance of securities, and also, to a certain degree, over application of proceeds, is in force, it is becoming apparent that railroad financing methods will undergo some modification.

Banking firms, particularly the primary houses which are first purchasers of most larger security issues, have realized some of the implications of the new order, not with unmixed satisfaction. They are aware that plants for security issues and for reorganization must be submitted to the Commission's division of finance, which is required to hold a public hearing on each application. This means some delay, and that involves the delicate and troublesome task of timing a public security offering to the capricious appetite of the investment market.

With a haunting memory of weary months through which rate cases used to drag, some Wall Street bankers have been apprehensive that time consumed in obtaining Federal authority to sell securities would mean the railroads might fall into the chronic condition of 'missing their market'. Such apprehensions, if one may judge from events to date, are groundless, for at least two reasons. One is that the division of finance, under Director Colston, a man of long experience in railroad law and finance, has been quick to see the need of expedition in affording a railroad needed capital. The other is that such applications, on forms prepared by the division of finance, are submitted in such detail that little time is required in the hearing to bring out all pertinent facts. As a rule, no opposition develops.

The mere fact that Federal control of securities has actually supplanted that of the dozen or more States which formerly exercised such powers, is admittedly a great offset to any possible disadvantage. That was the purpose of the law, and to all intents it has been achieved. In one case a State in which the applicant carrier operates made a formal effort to save its jurisdiction of securities, but apparently nothing has come of it, at least not yet.

In official circles it is doubted whether the banking community fully realizes the willingness of the Commerce Commission to facilitate necessary and legitimate work of financing railroads. In approving a certain issue of bonds, the Commission commented that the bonds had been sold by the railroad, subject to approval of the Commission. In some Wall Street quarters the comment was interpreted as disapproval of such a practice. It should not be supposed that a sale of bonds in advance of the Commission's action could ever be regarded as a successful means of bringing pressure to bear on the Commission to approve an issue it would not have approved otherwise, and in advance of the sale. No such case has arisen, and the Commission has no idea that any will. But this is a new function of the Commission, and precedents to govern it in future are in the making.

Probably the most important effect of Federal securities regulation will be that railroads will make financial plans further in advance than heretofore considered necessary, and may even adopt the practice of obtaining Commission approval of financial plans long before intended execution. The secrecy which bankers and railroad executives have habitually regarded as an essential part of their negotiations, up to moment of a public offering, may become a less binding rule.

MONEY AND EXCHANGE

Foreign exchange rates November 9 are as follows:

Sterling, commercial	Cable		3.47
	Demand		3.38
France, francs	Cable		5.81
	Demand		5.85
Lire, cents	Demand		2.80
Marks, cents			1.70

Eastern Metal Market

New York, November 3.

Buying initiative is largely absent from all the markets. While the price movement is still downward, it is less strongly so.

Copper has reached the 15c. level with little response by consumers, though they recognize its cheapness.

The tin market is firmer but buying by consumers is light; it is also speculative.

There is little demand for lead and prices are a little lower.

Quotations for prime Western zinc have receded slightly with light offerings and little demand.

Antimony is lower.

IRON AND STEEL

Pig-iron producers have made a quick response to the falling off in consumption, says 'The Iron Age'. Thirty-two fewer furnaces were in blast November 1 than one month previous—a falling off that has few parallels. October production of pig-iron held up well, the total being 3,278,104 gross tons, or 105,745 tons per day, as against 3,129,323 tons in the 30 days of September, or 104,310 tons per day. Thus October was the record month of the year, apart from March, and only January showed a larger total in 1919. Thirty-five furnaces blew-out last month and only three blew-in, and 287 furnaces were active November 1, against 319 one month previous.

In pig-iron as in steel the Steel Corporation's production has been nearer capacity than that of other makers, in view of the considerably larger tonages on its books in all lines.

With furnaces blowing-out, coke is more plentiful and another $2 has come off the price, making a decline of about 50% in three weeks. From $9 to $10 has been paid for furnace-coke, with a downward trend still indicated.

COPPER

Copper, both electrolytic and Lake, can be bought from most of the large producers as well as in the outside market as low as 15c. for delivery in the next two months and at 15.25c. for delivery in the first two months of 1921. The entire situation is not spoken of by large producers as encouraging or satisfactory and whether the bottom has been reached they have no opinion. The market has been slashed and they know it and are trying to make the best of it. Perhaps small lots could be obtained down to 14.75c., but not yet from large producers. Buying is a little better than a week or two ago, but it is inconsequential. Stocks are admittedly heavy and production is being curtailed further. There is one ray of hope in that it is recognized that some day Europe must buy, for she needs copper in vast quantities and can get it nowhere else. There was a sale of 400 tons on the New York Metal Exchange Monday at 14.82½, 14.77, and 14.70c., all under the rule, in lots of 200 tons, 100 tons, and 100 tons respectively.

TIN

An explanation of the present unsatisfactory market and low prices is offered in the opinion that there are few buyers, too many sellers, and bad financial conditions. Relatively tin is very low in this market. Consumers here are probably using invisible supplies. The orders that have been afloat lately have been taken mostly by one large company, it is said. As a result the market is stale and dull and, despite the advance in London since early in the coal strike and especially since its apparent settlement, buyers still hold off. In the past week there have been still more sales under the rule on the New York Metal Exchange amounting to about 150 tons of both spot and future-shipment metal at prices ranging from 39.30 to 41.25c. On Monday last spot Straits tin was quoted at 39.50c., New York, yesterday having been a holiday. The price has hovered around 40c. for a week or so. In London the metal has advanced and on Monday spot standard stood at £266 per ton, future standard at £267, and spot Straits at £270, the latter £10 above the price on October 26, a week ago. Deliveries into consumption in October were 3415 tons, of which about only 315 tons is credited to Pacific ports. Stocks and landing on October 31 were 3191 tons.

LEAD

This market is flat and dull—featureless in the extreme. The only item of interest is the fact that the domestic market is now below the cost of importation which will remove that competitive factor perhaps for some time. The cost of importation is not less than 7.50c., duty paid, seaboard, while spot and shipment-lead as well as metal in transit is offered and sold at 6.90c., New York, with liberal offerings at 6.65c., St. Louis. Demand, however, is not equal to the supply, and consumption is on the decline. The leading interest has not yet changed its quotation of 7c., St. Louis, or 7.25c., New York.

ZINC

The market has a better tone than in some weeks and may be pronounced as considerably steadier. Prices for prime Western have, however, receded again to 6.90c., St. Louis, or 7.40c., New York, which we quote as the domestic market for early delivery. There is still some imported zinc reshipped from foreign ports, available at around 7.25 to 7.35c., seaboard or New York, but the quantity is not large and this material is less and less a factor.

ANTIMONY

There is no animation to the market and quotations for wholesale lots are nominally lower at 6.37½c., duty paid, New York, for spot and early delivery. Jobbing lots are quoted at 6.62½ to 6.87½c., New York.

ALUMINUM

No changes have developed. The leading producer's quotation for virgin metal, 98 to 99% pure, is still 32.90c. per pound, producer's plant, while in the outside market the same grade is quoted at 28 to 29c., New York.

ORES

Tungsten: There is no business and prices are nominal at $4.50 per unit for Chinese ore and $5 to $5.50 per unit for Bolivian ore. There is some inquiry from Europe, but direct shipments to Europe are reported cheaper from countries of origin than American shipments.

Ferro-tungsten is quoted at 90c. per pound of contained tungsten in guaranteed lump form and at 70c., not guaranteed, while the powdered variety is quoted at 78 to 85c. per pound.

Molybdenum: The market is flat and nominal at 75c. per pound of MoS_2 in regular concentrate.

Manganese: The quotation for high-grade ore is 45 to 50c. per unit with demand light. Importations continue very heavy, those for September having been 88,422 gross tons against 99,601 tons in August.

Manganese-Iron Alloys: Re-sale material dominates the market for both ferro-manganese and spiegeleisen. The former is obtainable in small quantities at $155, basis seaboard, and some sales have been made at this level. The regular quotation of producers is on a basis of $170, seaboard, for both foreign and domestic alloy. The nominal quotation for spiegeleisen is $75 to $80, furnace, with re-sale material available as low as $60. Sales have been made as low as $58.75. Importations of ferro-manganese in September were 6524 gross tons with the exports reported as 297 tons.

T. A. RICKARD, ... Editor

ACCORDING to official statistics received from Mexico City, the production of silver in Mexico during the year 1919 was 65,900,000 ounces, as against 62,500,000 ounces in 1918 and 42,000,000 in 1917. In 1915 the production was only 22,000,000 ounces.

AT the end of the first week in November the United States Mint had purchased 21,644,231 ounces of silver under the terms of the Pittman Act. Coinage during October included a million half-dollar pieces, 4¼ million quarters, and 6½ million dimes, in addition to 70 million nickel and copper coins. Gold coinage was suspended throughout the month.

IN this issue we publish a short account of the food-draft scheme as put into successful operation by the American Relief Administration. The writer of the article, Mr. Edgar Rickard, needs no introduction to our readers. We learn from him that California ranks fifth in the purchase of food-drafts, having purchased 9212 drafts, equivalent to $151,950 worth of food delivered in Europe. Altogether $5,239,000 worth of food has been distributed by this method. Any profit is turned over to the European Children's Fund.

ON November 16 the Calumet & Hecla Mining Company, together with its subsidiary enterprises, put into effect a cut of 15% in the wages and salaries of all its employees. At the same time a number of mines in the Michigan copper region, including Osceola Consolidated, White Pine, and La Salle, discontinued production entirely, and the forces at other properties were reduced, thereby throwing 1500 men out of work. There has been no profit in the copper-mining industry of Michigan for two years; some metal was being marketed, however, and most of the mines were kept in operation. Stocks of unsold copper, the limited market, and the current low price have combined to compel this recent drastic move. Similar action is reported from Bisbee and Jerome, except that the wages of the employees retained on the payroll have not been cut. Whenever there is any considerable reduction in the number employed the output per man automatically increases, so that direct mining costs are lowered. Apparently the operators in Arizona are content with this improvement without resorting to reductions in the wage-scale, at least until such time as a definite decline in the cost of living is demonstrable. It seems certain that prices will go down and that reduced wages will be the logical consequence. The action taken in Michigan is predictive of the general readjustment.

HOW much should a gold mine pay to be an attractive speculation? We find the suggestion of an answer to this query in a tabulated statement of the capital, dividends, and yield of the principal mines of the Witwatersrand. Our contemporary, 'The Mining World', of London, gives the data for 27 mining companies, of which we set aside three, because their mines are approaching exhaustion and therefore are expected to pay dividends that represent amortization rather than current interest. The remaining 24 show a yield of 14% per annum on the current market valuation of their properties. This indicates that the British public has learned from bitter experience to realize the essentially speculative character of all gold mining and now demands a rate of return commensurate with the inescapable risk. The greatest gold mine in the world, the New Modderfontein, pays 12% on its market price. We remember the days when the promoters and financiers of the Rand used to talk about 6% and 7% as sufficient interest and recommended their shares as fit investments for the trustees of widows and orphans. Most of the promoters liquidated their own holdings at top prices, leaving the public with an impoverished pocket and an enriched experience. The realization of the speculative character of gold mining on the Rand, or elsewhere, will not hurt the mining industry; it will serve chiefly to distribute the profits more fairly between the insiders and the public.

BUTTE is one place where the local issues decided at the election easily eclipsed in importance and interest the question of President Wilson and the League or any other national issue. It was the old fight of the radical labor element against the Anaconda Copper company; fortunately the business people of Butte and the more conservative miners and craftsmen decided in favor of the mining company. Incidentally the Republican ticket won in a city that always has been the stronghold of the Democratic party in a habitually Democratic State. At the primaries held some months ago Mr. William F. Dunn, publisher of a radical newspaper, the 'Butte Daily Bulletin', and eight or ten others whose sympathies were known to be with the more radical mine-workers, won nominations on the Democratic ticket for several important offices, including those of Sheriff and

District Attorney. Thereupon the charge was made that the Democratic party had been "stolen" and the Anaconda company, largely through the medium of the 'Anaconda Standard', a newspaper that has always been Democratic, started a bitter fight to defeat the 'wobblies' on the Democratic ticket. The Anaconda company professes to take no part in politics, but mining is the only productive industry in or near Butte and the Anaconda enterprise is so much bigger than all the other mining operations combined that it is conceded leadership. Without imputing any sinister motives, it may reasonably be said that the company cannot help being vitally interested in politics, and, while the new city and county officials will not, as the 'Bulletin' charges, take their orders directly from the "sixth floor" (alluding to the Hennessy building, where are the offices of the Anaconda company), we venture that the wishes of the company officials regarding the conduct of municipal and county affairs will be given respectful consideration. Any other view would necessarily attribute to the successful candidate a type of independence that is seldom displayed by astute politicians in Butte or elsewhere. During the campaign the threat was made unofficially that operation of the mines would be suspended indefinitely in the event that the objectionable Democratic candidates were elected. On the day before election the 'Bulletin' said on its front page, "If the Republican ticket is elected the wages of the miners and the craftsmen will be cut and those who object will be baptized with shrapnel and machine-guns"; while the 'Standard', on Tuesday, declared in a seven-column head, "The Destiny of Butte will be decided at the Polls today", and on the day following said, "It was a sweeping victory, not for the Republican party, but for law and order, for honesty, decency, and good citizenship". The officials of the Anaconda Copper company doubtless have made blunders at times in their dealings with the miners, and with the unions, but the crowd of which Mr. Dunn is a leader has repeatedly avowed allegiance to the principles of anarchy, to sabotage, and to violence. Nothing good could possibly come from their election to office, and Butte is to be congratulated on the result of the balloting. To what extent the local issue helped the Republican national ticket, and how much the sentiment for Senator Harding favorably affected the vote for the candidates on the Republican county ticket, can only be guessed; at any rate, the Hardinge-Coolidge electors received a substantial majority in Silver Bow county, of which Butte is the county seat.

WE went to press last week too soon to be able to report the meeting of the San Francisco section of the Institute at which Mr. Hoover was present (in his official capacity as president of the Institute. A large attendance graced this special occasion and Mr. Hoover [illegible] by a speech crowded with interesting information. He referred to the increase of membership [illegible] increase that, we venture to suggest, is due largely to the fact that our president is a man who himself illustrates supremely the chief function of the engineer as one who converts the resources of nature to the use and benefit of man. In his own career during recent years Mr. Hoover has provoked a comparison between the destructive performances of the diplomat and the constructive activities of the engineer. He told his audience something about the proposed Federation of Engineers, the organization of which is to be perfected at a meeting in Washington on the 17th instant. He touched upon the intermittency of labor in the coal regions, giving 180 shifts per annum as the coal-workers average portion, and emphasized the economic necessity for systematizing the extraction, storage, and distribution of coal so as to prevent the waste of time, energy, and money. Speaking of the defective distribution of power in the industrial region of the Atlantic seaboard, he mentioned a project for building an electric trunk-line from Washington to Maine to be used as a means for conducting power and distributing it over branch-lines to industrial centres. In response to a question, he described the work being done by the American Relief Administration, and in response to another question, he dwelt upon the utter failure of communism in Russia, suggesting a warning to our radicals and dreamers. He urged all present to bring pressure upon their representatives in Congress to support the bill for a Federal Department of Public Works; in short, he gave us a crowded hour of live information and stimulating thought.

A RECENT discovery in Canada affords a nice illustration of the incidence of economic considerations on the technical distinction between a 'mineral deposit' and a deposit of 'ore'. The former, of course, is the more comprehensive term. It is reported that on August 25 oil was found at a depth of 783 feet in a drill-hole near Fort Norman, which is situated on the Mackenzie river and near the Arctic circle. The six-inch casing was capped after flowing for half an hour at a rate estimated at 1500 barrels per day. Whether this estimate be accurate or not is immaterial; there seems to be evidence of the existence of a good supply of oil. However, even if a hundred wells of this size were 'brought in' near Fort Norman, they would have no economic value as an immediate source of petroleum products for southern Canada and the United States. From Fort Norman to the nearest railroad is 1200 miles and to the nearest navigable river the distance is approximately 900 miles. Numerous streams capable of floating boats of shallow draught appear on the map to afford a route, but sundry rapids necessitate frequent portage, thereby precluding the shipment of a bulky cargo. Moreover, on account of the Arctic cold the rivers are open to navigation for only a few months during the year. The construction of a pipe-line, according to the engineers of the Imperial Oil Company, would involve an expenditure of some $50,000,000, so that there is little likelihood of such a project being undertaken until various other sources of supply have been exhausted. Obviously, if enough productive districts were discovered in the region and if the demand, and consequently the price, were increased sufficiently, the difficulties of exploiting the oil would be

overcome. We venture to say that the shale of Colorado and Utah will have been made to yield the tremendous quantities of oil that they contain before we turn to the Arctic region as a source of crude petroleum.

The Bingham Decision

In this issue we publish the larger part of the opinion handed down by Judge Tillman D. Johnson, of the U. S. District Court for Utah, on October 20, in the first of a series of suits between the Utah Apex Mining Co. and the Utah Consolidated Mining Co. arising from disputes over the ownership of ore in sundry beds of limestone at Bingham, Utah. The trial was completed last January, at which time Judge Johnson took the cases under advisement. In the two principal controversies no vital question of apex or extra-lateral rights arose. The expert witnesses on both sides agreed so closely as to the position and physical characteristics of the beds and lodes that the Utah Apex company agreed to accept the maps and other exhibits of its opponents as correctly representing the conditions existing in the two mines; the two geologic sections given elsewhere in this issue are adapted from the exhibits of the Utah Consolidated company. They present the salient points clearly. The section on page 727 shows the issue in the first case, wherein the Utah Consolidated was the defendant. The Utah Apex company sought to recover $1,750,000 for ore that, it alleged, had been wrongfully mined by the Utah Consolidated from the Leadville orebodies. The defendant contended that the Highland Boy limestone stratum was a continuous broad lode, and so designated it on its exhibit. In our drawing we have substituted the words 'limestone bed' for 'lode', to conform with the decision of the Court. The geologists who testified for the Utah Consolidated defined a lode as "mineralized rock or rocks which contain such indications of valuable minerals as to justify development with the expectation of finding ore. As soon as quartzite over a considerable distance becomes mineralized, then it becomes a lode. Just as soon as either of the other rocks can produce and do produce ore, or contain indications which lead the experienced miner or prospector of judgment to develop it in expectation of finding ore, then it becomes a lode." Around this definition of the statutory meaning of 'lode' the argument of the defendant was built. The cases of Richmond Co. v. Eureka Co. and U. S. Mining Co. v. Lawson were cited by the defendant, who urged that the conditions were so nearly parallel that those decisions, wherein the courts had held that particular limestone beds fulfilled the requirements of the definition of 'lode', should be accepted as a valid precedent. The Utah Apex attorneys contended that the Highland Boy ore deposit is a broad lode limited by the porphyry dike, shown immediately to the right of the principal stopes, and offered evidence to prove that for a distance of a quarter of a mile between the Highland Boy and Leadville orebodies the limestone is unaltered, and that the adjacent quartzite contains more lead than does the limestone; they argued that the two orebodies were entirely independent of each other. In his findings Judge Johnson points out that the limestone strata in the cases cited were so broken, crushed, and fissured, and so impregnated with metalliferous minerals as to be clearly distinguished as lodes; but that this does not appear to be true with respect to the limestone in the present controversy. He declares that he cannot escape the conviction that, in the course of twenty years of profitable mining, the defendant would have explored the long stretch of limestone between the two orebodies, had there been "reasonable expectation of finding ore." The decision sustains the contention of the Utah Apex company that the limestone is not a lode, and that the orebodies are identified with sundry steeply pitching fissures, variously called faults, fault-fissures, fissure-zones, and fissure-veins by the geologists who testified at the trial. A slightly different question is involved in the second suit as illustrated in the sectional drawing on page 729. Here the positions are reversed in that the Utah Consolidated company alleges wrongful extraction by the Utah Apex of ore in the Yampa limestone bed, the orebodies in controversy being indicated by the stopes above and below the Apex 1300-foot level. The plaintiff had mined a foot-wall vein which follows the contact between the limestone and the underlying quartzite; the contention was again made that the limestone forms a thick lode; it was argued that any orebodies within its limits are part of the lode. The Utah Apex conceded the ownership of the Yampa foot-wall vein, but denied any geologic connection between this vein and detached orebodies in the overlying limestone. We have not printed the decision of the Court in this case, since the conclusions are reached by much the same line of reasoning. The Utah Consolidated company, since the announcement of the decision, has voluntarily discontinued mining the Leadville orebodies, and its engineers are now engaged in calculating the value of the ore wrongfully removed. This estimate will be subject to exception by the Utah Apex company, in which event the Court will be called upon to determine the amount of damage.

The Divining Rod

By way of introduction, we may say that a few days ago a man called at this office to ascertain where he could buy a divining rod, which he wanted for use in finding some buried gold near Vallejo, at the northern end of the Bay of San Francisco. He was shown the proof of the article by William Pryce, appearing in this issue, and he asked particularly for the drawing given by the old Cornishman because he intended to make a divining rod for himself.

On another page we publish an excerpt from that remarkable old book, 'Mineralogia Cornubiensis', by William Pryce, of Redruth. This book, which is the 'Agricola' of Cornwall, was published in 1778 and is full of genuine information on mining affairs. Among other subjects discussed by Dr. Pryce is the divining rod, to which he gives the larger part of a chapter headed, 'Of the various Methods of discovering Mines'. His remarks on

the *virgula divinatoria* are full of good sense. He is "well convinced of its absolute and improveable virtues", but he does not undertake to decide upon the properties attributed to it, especially as he has found by trial that it does not work when in his own hands. However, it does extraordinary things when in the hands of friends whom he knows to be men of integrity, and not at all likely to deceive either themselves or others, so he is prepared to take it seriously. He finds that it works with some and not with others; it gives qualitative results but not quantitative; "it has been found to dip equally to a poor lode and to a rich one". The old Doctor tells us how his friend Mr. Cookworthy "satisfied the curiosity of some gentlemen" by finding "a lode that had been wrought" and by tracing another lode from a sea-cliff inland. Thirty years ago we had such a friend, who wielded the divining rod or forked stick of enchantment; he was Charles Latimer, the president of a Cleveland mining company, an old gentleman without guile. The Foxhall tunnel in Seaton mountain near Idaho Springs had cut a number of veins; we took Mr. Latimer into the tunnel, or adit, and arranged that he should walk ahead with the rod in the dark along the track and indicate the various veins as he came to them. He did. Later we hid a bunch of keys, a piece of copper, and a lump of galena in different parts of a room; he found them and labeled them iron, copper, and lead. Like Pryce, he had no explanation to offer. The various theories propounded by the old Cornish worthy are just about as intelligible as those advanced in these later days. We moderns talk about electric currents instead of effluvia, we use the modern jargon in place of the medieval, but we are no nearer the secret. Authentic accounts of the finding of water by 'dowsers', as the wielders of the rod are sometimes called, are numerous, and that the rod in the hands of some people will perform strange antics, there is no doubt. Like Hamlet, we conclude that there are more strange things in this world than are dreamt of in our philosophy.

The occult survives in contraptions even more dubious than the divining rod. We read recently of a gentleman at Haileybury, in Ontario, who owns an instrument "for locating the presence of the precious metals". He was being backed by a New York syndicate for the purpose of finding the treasures hidden by Captain Kidd on the Cocos islands. Mr. Andrew B. Cullen, this new diviner, had made demonstrations at Cobalt that had aroused "a moderate amount of curiosity" and there were "those among the prospecting fraternity who appear to believe that the instrument has some merit". It works "on the principle that affinities attract each other, and that by the proper use of a small piece of gold the instrument will point out the location of an ore deposit or hidden treasure containing gold". Another diviner appeared three months ago at San Antonio, Texas. His name is Professor L. V. J. Kimball. We read in the 'San Antonio Express' that his method likewise is based on "the principle that affinity". Orebodies containing gold and silver can be located, says he, "by use of magnetic needles of the proper affinity to within a few inches of their position in the earth". In searching for "the chemical that would respond to gold" he has discovered the affinities that answer to 75 other substances. The Professor worked in the mines of California and "became disgusted with geology", because its methods were so uncertain. So he set to work and made the discovery that led to the invention of his 'finder'. It is a battery, which is "purely magnetic and not electric". All mineral substances, he says, are magnetic. They throw off magnetism. He has learned how to insulate magnetism. That is the secret. Of course, he will not divulge his method. It will not work with everybody, "because some people are electric while others are magnetic". He has said something, has he not? His instrument will detect oil at 25 miles and gold at 8 to 10 miles "at the farthest". Even that is a considerable achievement. He can operate "while riding along in a railroad coach or an automobile". What a grand way of scouting for possible mines in the wide and expansive regions of our West! Professor Kimball will not sell his services to Wall Street. No, Sir! His eyes blazed with indignation as he told the highly intelligent reporter "of an offer of a fabulous fortune for his instrument, with a big annual salary attached, made by a big corporation which proposed to use him and his instrument solely for their own purposes and to deny the rest of mankind the benefit of it". Damned greedy of them, say we. However, the attachment of that "big annual salary" seems rather to spoil the story, for the "fabulous fortune" appears almost to suffice. Even in the Antipodes they have their little fakes. We read that "a considerable amount of local interest has been aroused by reports that a 'diviner' had located two large gold-bearing quartz reefs at Little Plains" in New South Wales. He traced them for six miles; but Mr. L. J. Jones, of the Geological Survey, was unable to find anything "in the nature of a quartz reef in the various outcrops examined". Mining operations failed to confirm the divination and local excitement has subsided, we are informed. The miners have returned to the dreary drudgery of digging as a means of search for the precious metal.

The alchemy of one age is the chemistry of another, so the divining rod of a former century may prove to be the forerunner of a scientific device for detecting the precious things hidden in the crust of the earth. For the present, however, we remain sceptical. Indeed if ever somebody does discover some 'Open Sesame' in the prospecting way, he will, we presume, keep his secret to himself or at most share it with one or two trusted friends. We suspect the owner of an ore-finding device just as soon as he advertises his willingness to find ore for other people, even at a price. As yet all these queer instruments, whether a forked twig or an electric apparatus, at their best are merely qualitative, they fail to distinguish between poor rock and rich mineral, that is, they show no economic sense, they confuse 'waste' with 'ore'. The inventors and exploiters of these devices remind us of an advertisement we saw long ago in a Cripple Creek newspaper; it offered the services of spiritism to find an orebody. Yet the advertiser's address was Poverty Gulch. That is where most of these gentry remain.

Minerals Separation in Chile

The Editor:

Sir:—I have just read with great pleasure the testimony given by you before the Federal Trade Commission during the hearing of the complaint against the Minerals Separation companies. Let me, therefore, congratulate you for your admirable evidence and at the same time assure you that all the "sinister imputations" of Minerals Separation against your well-established reputation for straight and fair dealings or against your never-questioned honesty will not shake in the slightest the faith and regard that the subscribers of the 'Mining and Scientific Press' have for you. As one of them, I protest strongly against such insinuations; though they are only degrading to those who make use of them.*

I have always followed with great interest your long, courageous, and praiseworthy campaign in the 'Press' against the mean and underhand methods of Minerals Separation, by which they have mainly endeavored to stifle and suppress the dissemination of all knowledge relating to flotation and to obtain an absolute monopoly over everything that relates to a process to the discovery and improvement of which they were, as you justly believe, only contributors.

I am sure it will be of interest to you to know what Chilean mining men think of Minerals Separation.

Señor Gandarillas Matta, the president of the society, in his address said that he wished to call attention to a subject of great importance to the mining industry, about which he had received several protests from responsible mining men. He referred to a notice published lately, about a petition which the Minerals Separation company had made to the Government asking for an extension of another 20 years to exploit in Chile their patents covering the concentration of ores by flotation.

"The Sociedad Nacional de Mineria," he said, "must take notice of the danger which such a petition entails to the copper-mining industry."

All the members of the committee were in accord in the necessity of preventing "by all the means at their command" the continuance of such a state of things in Chile for another twenty years.

The sending of a resolution to the Minister for Industries was approved, explaining the situation, accompanied by the complete vote of the American Mining Congress, and asking the Minister to refuse to grant the extension asked for by Minerals Separation.

The text of the resolution sent to the Minister for Industries was published, together with the vote of the American Mining Congress, by the 'La Union' of Santiago and the 'La Nacion' of Valparaiso, as follows:

"The committee in their last meeting approved the calling of your attention to a notice published lately in the press of this capital which, if it were true, entails very grave danger to the copper industry of the country.

"According to this notice the Minerals Separation company has asked the Government to extend for 20 years more the right to exploit in this country their patent-rights covering their systems of concentrating ores by flotation.

"This notice, which may pass unperceived by the public, is, however, of enormous importance, which is the duty of the Sociedad Nacional de Mineria to bring forward.

"The Minerals Separation company owns the patent-rights of concentration by flotation, which is the only one commercially applicable to the majority of Chilean copper deposits.

"The large low-grade deposits would yield a small profit per ton if treated by this system, and their owners could work them upon a more or less sure basis, by treating large masses that today have only a relative value.

"The Minerals Separation company has received for many years the benefit of their patents and in Chile itself has been receiving by their use about £50,000 per annum. In this the company has been protected by their patents, from the legal point of view, but has used objectionable methods in the giving out of licenses. The license agreements to which the licensees are subjected are truly despotic and one-sided (*leoninos*) not only on account of the high dues demanded but also because of all kinds of obstacles and severe conditions imposed.

"We will not allow the truth of these assertions to rest solely on ourselves, but will quote in our behalf an authority of world-wide reputation in this matter.

"The American Mining Congress is an institution that meets annually in the United States with the assistance of delegates from all the mining States, together with the most distinguished mining engineers and business men connected with mining enterprises. This Congress, in its meeting of the 21st of November 1919, at St. Louis, unanimously approved the following vote. [The translation into Spanish of the vote follows.]

"If such has been the conduct of the Minerals Separation company in the United States, you will understand that there has been no reason to make it more gentle in Chile.

*Allowance must be made for the charming exaggerations of Spanish custom. The 'caballero' makes us blush.—Editor.

"And if such has been the condemnation that its monopolistic policy has merited, we can see no reason why we should allow it legally to continue to exercise it here for another 20 years.

"The rights of the inventor have already been well paid for and what up to now has been a legal reward to the discoverer of the process would become an irritating monopoly that no legislation can sanction.

"The royalty of six pence per ton which up to now Minerals Separation has been charging is without a doubt very high, but has been accepted as a tribute to the intelligence of the discoverer, under the protection of the law.

"But there must be a limit to this. In so essentially a mining country as Chile, where the future of the copper-mining industry is so closely connected to the exploitation of low-grade deposits, flotation is absolutely indispensable and must be declared a public utility.

"For these reasons we ask, that when the opportune moment arrives, your high influence be used so that the original patents of Minerals Separation be declared expired and that under no pretext will new privileges be conceded to this company in this country."

Let us hope that the Chilean Minister for Industries takes the advice of the Sociedad Nacional de Mineria and refuses to extend for another 20-year period the patent-rights of Minerals Separation in Chile. If so, the first complete victory against the soulless patent-exploiting combination may be said to have been won; and no small credit for it will be due to you, Mr. Editor.

Santiago, Chile, September 23. INGENIERO.

Two Suggestions on a National Problem

The Editor:

Sir—In reply to the letter by M. W. von Bernewitz in your issue of October 16, he seems to take the stand that he may draw inferences from my letter, but that I must not do so from his. He appears to be under the impression, too, that my letter was antagonistic to his, whereas, of course, it was not intended to be anything of the kind. His letter simply formed an incentive to air my own views on the subject.

I freely admit that I did infer from his letter in your issue of August 14 that Mr. von Bernewitz considered the method of storing gas on automobiles in England during the War was a stupid method, and admittedly it would have been a stupid method had there not been an excellent reason for it, as I stated in my letter of September 11. Mr. von Bernewitz said: "According to Captain Brewer, who addressed the engineering societies in San Francisco a couple of years ago, during the War, some automobiles in England used city gas, which was stored in an unsightly bag atop of the machine. This gas was at low pressure, supplied by gas-works. My suggestion is to compress the gas to several hundred pounds, store it in a receiver on the machine, and pass it through a reducing-valve before use." The storage of gas at high pressures (often several thousand pounds) for many purposes has been such a common practice in England for so many years that Mr. von Bernewitz by his suggestion did seem to me to imply stupidity that it was not done, and I think it probable that many others made the same inference. Once again, I did not intend to convey the impression that Mr. von Bernewitz thought the fuel situation cause for panic. I simply said that I did not, though I considered it serious.

Mr. von Bernewitz was justified, perhaps, in making the inference that I thought he was advocating the use of producer-gas for raising steam, though I did not say so. I should have worded the sentence a little differently, and then would have avoided the ambiguity. Producer-gas has been, and is, used in Europe for raising steam, and there was justification for such use before the fixation of nitrogen from atmospheric air had been accomplished, and before the improvement in methods of burning finely pulverized fuels. More ammonia is obtained from the fuel when converted into producer-gas than by any other method, and this to some extent relieved the immense drain that was being made on the nitrate deposits of the Tarapaca and Tacoma valleys, in Chile and Peru. With improved methods of burning pulverized fuel, allowing many low-grade fuels to be used, there does not seem to be the same justification for the use of producer-gas for raising steam.

Notwithstanding its use in Europe, the employment of a gas containing 60% of inert matter as an internal-combustion-engine fuel does not appeal to me as good practice, especially when we consider that for every volume of oxygen used for its combustion four volumes of nitrogen has to be introduced, making the total amount of inert material rather appalling. Some day, if Dr. Cottrell's dream of the use of oxygen materializes, and there seems to be no reason why it should not, this may not be necessary.

The increased use of the internal-combustion engine has been so rapid that it entirely has overtaken the production of suitable fuels for its operation. These, I believe, will come in time. In the meantime, anything that will help to solve the problem is of national importance, and I have no desire to decry the use of producer-gas, or anything else, that is likely to bring relief. We see things from different angles, however, and thoughtful discussion should produce good. As an illustration of how widely sometimes those angles diverge, I was interested to read in an industrial chemical journal recently condemnation of attempts to make alcohol for motor-fuel synthetically from acetylene, on the ground that if, instead of converting the calcium carbide into acetylene, it were converted into nitrolime, or calcium cyanamide, and utilized as a fertilizer the increase in the production of grain would be capable of making four times the amount of alcohol that could be made directly from the carbide. As to the accuracy of this, I know nothing. The agricultural part is outside my line of thought. There is, however, a great field open to the industrial chemist in the manufacture of alcohol from waste products.

Victoria, B. C., October 23. F. H. MASON.

Utah Apex v. Utah Consolidated: Abstract of the Court's Opinion

The parties to this action are corporations engaged in the business of mining. They own adjoining properties in Bingham, a mining camp situated a few miles southwest of Salt Lake City, in this State. Certain of the mining claims of the plaintiff lie north of and adjacent to certain of the mining claims of the defendant. Prior to the commencement of this action the defendant had entered beneath the surface of the adjacent claims of the plaintiff and began to remove and appropriate valuable ores and mineral found therein. By this action the plaintiff seeks to enjoin further entry by the defendant within the premises of the plaintiff and the removal of the ores and mineral therein, and for an accounting.

The defendant in its answer admits that it has entered beneath the surface of the mining claims owned by the plaintiff, and that it has removed, and will continue to remove, the ores and mineral found therein, and justifies its action in so doing on the ground that the ores and mineral beneath the surface of the plaintiff's property are within a broad lode apexing within the boundaries of the mining property of the defendant, and that the said ores and mineral found within said lode beneath the surface of the mining property of the plaintiff belong to and are the property of the defendant by virtue of the extra-lateral rights conferred by the laws of the United States in such cases.

Geologically the country involved in this litigation consists of an underlying quartzite bed or stratum of unknown extent and thickness. Upon this quartzite there is a limestone bed, called the Highland Boy limestone, of an average thickness of about 250 ft., but varying in thickness from about 100 to 400 ft. Above the Highland Boy limestone there is a bed of quartzite having an average thickness of about 250 ft., and above this quartzite bed there is another limestone bed, called the Yampa limestone, with an average thickness of about 200 ft., but varying in thickness from a few feet at or near the surface to 400 or 500 ft. at depth in the neighborhood of the steepening of the dip of the limestone. Above the Yampa limestone there is a quartzite stratum having a thickness of about 700 ft., and above this stratum of quartzite a limestone bed, called the Parnell, of about 30 ft. in thickness. Upon the Parnell limestone rests a quartzite bed containing within it here and there thin lenses of limestone. This bed of quartzite has a thickness of about 280 ft. Above this quartzite there is a thin bed of limestone called the Petro, and above the Petro an indefinite thickness of quartzite in which are found here and there thin lenses of limestone.

The limestone and quartzite beds above mentioned are sedimentary rocks and, as laid down in the bottom of the ocean, were originally level. Later and in the mountain-making of this region these sedimentary beds were uplifted and more or less tilted and bent so that now they have a dip northerly at the surface and for some considerable distance below the surface of about 30°, and an easterly and westerly strike across the country.

Subsequent to the mountain-building which resulted in the tilting of these sedimentary beds of limestone and quartzite there was an intrusion of porphyry—an igneous rock coming up from the depths, apparently from the south and east—which cut through, absorbed or threw aside portions of the sedimentary beds of limestone and quartzite lying above. After this intrusion of porphyry the ores and mineral contained in the mining properties of the parties to this action were deposited.

The ores and mineral in controversy in this action are found beneath the surface of the mining claims of the plaintiff in the Highland Boy limestone and only to a limited extent in the quartzite above or below it. The outcrop or apex of the Highland Boy limestone is within the boundaries of mining claims owned by the defendant. On its dip to the north the Highland Boy limestone passes beneath the surface of the mining claims of the plaintiff where, as already stated, the disputed ores and mineral are located which in the testimony are called the Leadville orebody and the locality spoken of as the Leadville country.

The Leadville orebody is a relatively narrow (as compared with the various other orebodies involved in this series of litigation) and practically continuous body of ore extending about 2000 ft. in a north-easterly and south-westerly direction along the course of what has been variously spoken of by the witnesses as a fault, a fault-fissure, a fissure, a fissure-zone, a fissure-vein. The ore is a lead ore found east of the fissure making out into the limestone.

Up the dip of the Highland Boy limestone about one-fourth of a mile from the Leadville orebody there has been developed and mined an immense deposit of ore. This deposit was made up of a great number of closely associated and related orebodies almost entirely in the limestone and extending in length for a distance of approximately 3000 ft. in a north-easterly direction, roughly paralleling the Leadville orebody, and from 200 to as much as 1000 ft. in width. All of these orebodies were copper ore except a few found near the surface, which were lead.

The maps and models introduced in evidence by the parties show more clearly than words can describe a great mass of porphyry adjacent to and lying south of and below the outcrop of the Highland Boy limestone in the mining claims of the defendant.

There is also shown upon the maps and models down

the dip of the Highland Boy limestone a comparatively narrow sheet and fingers of porphyry extending up and cutting through the Highland Boy limestone above and north of the orebodies above described, with one or two exceptions, and inclosing between this sheet and fingers of porphyry and the great mass of porphyry lying south of and below the apex of the limestone the segment of the Highland Boy limestone in which these orebodies were deposited.

This great deposit, lying south of and below the sheet and fingers of porphyry, is admitted by the plaintiff to be a broad lode.

At this time I will say I do not think the admission of counsel for plaintiff, made in his opening statement, that plaintiff conceded the orebody bounded on the foot-wall side by quartzite and porphyry, and on the hanging-wall side by the sheet and fingers of porphyry above mentioned, was a broad lode, or the testimony of plaintiff's witnesses to the same effect, shifted the burden of proof.

Lying between this admitted broad lode and the Leadville orebody is a body of the Highland Boy limestone of about 250 ft. in thickness and extending north-easterly about 2000 ft. and north-westerly about 1400 or 1500 ft. This intervening limestone has been explored only to a very limited extent. Five or six years ago the defendant ran a drift on the 1300 level westerly from the vicinity of the main shaft of its upper mine through the Highland Boy limestone, a distance of about 1800 ft., to an intersection with the Leadville fissure. This drift was continued westerly and north-westerly several hundred feet through the limestone and overlying quartzite to the Yampa limestone. It was at this time that the Leadville ores were discovered by the defendant. The subsequent mining and removal of these ores have occasioned this lawsuit.

After the discovery of the Leadville orebodies the defendant ran a cross-cut from the 900 level of its upper mine through the limestone westerly down and into the Leadville country. More recently it has run a drift on its 1600 level, from the vicinity of the main shaft of the upper mine, through the limestone to the Leadville country. There is also a cross-cut from the 700 level of the upper orebody through the Highland Boy limestone and the overlying quartzite to the Yampa limestone. In addition to these drifts and cross-cuts run into and through the limestone intervening between the upper and Leadville orebodies, there are numerous drifts and cross-cuts from the main workings of the upper mine, and a few drifts and cross-cuts from the main workings of the Leadville orebody extending a comparatively short distance into this intervening limestone.

A glance only at the maps and models of the parties makes it manifest that this intervening country is undeveloped and unprospected. The drifts and cross-cuts into and through the intervening limestone above the drift on the 1300 level show the limestone to be unmineralized, in the main unaltered, and but slightly fissured [illegible] upper or the Leadville orebodies. Indeed this is admitted by the defendant in its brief. It is stated:

"In this area of little development, its upper portion is correctly described as unaltered barren limestone."

In the drift upon the 1300 level there is a slight showing of mineral at two or three places, and also some fissuring along the drift. In the drift upon the 1600 level there are more evidences of mineralization and the rock is more extensively altered and fissured. There is mineralization found in this drift in the neighborhood of the Leadville fissure which may be, and probably is, connected with the Leadville orebody. There is also mineralization and a little ore found further to the east in this drift and referred to in the evidence as Litigation stope. This mineralization has not been developed sufficiently to determine its value or its connection, if any, with either the upper orebody or the Leadville orebody.

It is the contention of the defendant, based upon numerous considerations, that this undeveloped body of the Highland Boy limestone is good prospecting ground in which the miner may work with reasonable expectation of finding ore anywhere, and that it is a part of the broad lode as conceded by the plaintiff. In other words, it is the contention of the defendant that the Highland Boy limestone, outcropping upon the mining claims of the defendant and extending on its dip beneath the surface of the claims of the plaintiff, is one broad lode. The plaintiff controverts these contentions of the defendant and asserts that this undeveloped limestone is a body of barren limestone breaking the continuity of the upper orebodies and clearly constituting an area of separation between the two orebodies, and, in addition, maintains that the porphyry sheet and fingers above and overlying the orebodies, admitted by it to be a broad lode, constitute the north boundary of the lode.

Our first consideration, then, is: What constitutes a lode within the meaning of the statute? What are its characteristics and nature? What its extent, its limits, and boundaries?

"The locators of all mining locations heretofore made or which shall hereafter be made, on any mineral vein, lode, or ledge, situated on the public domain, their heirs and assigns, where no adverse claim exists on the tenth day of May, eighteen hundred and seventy-two, so long as they comply with the laws of the United States, and with state, territorial, and local regulations, not in conflict with the laws of the United States governing their possessory title, shall have the exclusive right of possession and enjoyment of all the surface included within the lines of their locations, and of all veins, lodes, and ledges throughout their entire depth, the top or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes, or ledges may so far depart from a perpendicular in their course downward as to extend outside the vertical side-lines of such surface locations. But their right of possession to such outside parts of such veins or ledges shall be confined to such portions thereof as lie between vertical

planes drawn downward, as above described, through the end-lines of their locations, so continued in their own direction that such planes will intersect such exterior parts of such veins or ledges. And nothing in this section shall authorize the locator or possessor of a vein or lode which extends in its downward course beyond the vertical lines of his claim to enter upon the surface of a claim owned or possessed by another."

The defendant cites the Eureka case, 4 Sawyer 302, 311, 8 Federal Cases (No. 4548), and urges with great earnestness that the facts of that case are so nearly analogous to the facts in the case at bar that no other conclusion is possible than that the Highland Boy limestone constitutes the lode, as the zone of limestone was found to be the lode in that case.

The defendant not only urges the similarity of conditions as deduced from the statement of facts found in the opinion, but relied upon testimony of witnesses called by it who testified that the conditions existing in the two mines were similar, one of whom had recently been in a portion of the Eureka mine and who testified to his observations. Inasmuch as this testimony was received during the progress of the trial and is commented upon by counsel for the defendant in argument, it is only fair to say that the weight which I shall give to the Eureka case as an authority will be based upon the facts stated in the opinion. The testimony of witnesses conflicting with the facts stated in an opinion cannot, in my judgment, either enlarge or limit the authority of the opinion in another case before another court. Upon the facts stated in the opinion, the Eureka case is a most valuable one for our consideration in this case, and requires more than passing notice. Judge Field, who wrote the opinion, in respect to the facts said:

"The mining ground which forms the subject of controversy is situated in a hill known as Ruby Hill, a spur of Prospect mountain, distant about two miles from the town of Eureka, in Nevada. Prospect mountain is several miles in length, running in a northerly and southerly course. Adjoining its northerly end is this spur called Ruby Hill, which extends thence westerly, or in a south-westerly direction. Along and through this hill, for a distance slightly exceeding a mile, is a zone of limestone, in which, at different places throughout its length, and in various forms, mineral is found, this mineral appearing sometimes in a series of succession of orebodies more or less closely connected, sometimes in apparently isolated chambers, and at other times in what would seem to be scattered grains."

After discussing at some length the statute and the definition of a lode within the meaning of the statute, he proceeds:

"Examining, now, with this definition in mind, the features of the zone which separate and distinguish it from the surrounding country, we experience little difficulty in determining its character. We find that it is contained within clearly defined limits, and that it bears unmistakable marks of originating, in all its parts, under the influence of the same creative forces. It is bounded on the south side for its whole length, at least so far as explorations have been made, by a wall of quartzite of several hundred feet in thickness; and on its north side, for a like extent, by a belt of clay, or shale, ranging in thickness from less than an inch to 70 or 80 ft. At the east end of the zone, in the Jackson mine, the quartzite and shale approach so closely as to be separated by a bare seam, less than an inch in width. From that point they diverge, until, on the surface in the Eureka mine, they are about 500 ft. apart, and on the surface in the Richmond mine, about 800 ft. The quartzite has a general dip to the north, at an angle of about 45°, subject to some local variations, as the course changes. The clay or shale is more perpendicular, having a dip at an angle of about 80°. At some depth under the surface, these two boundaries of the limestone, descending at their respective angles, may come together. In some of the levels

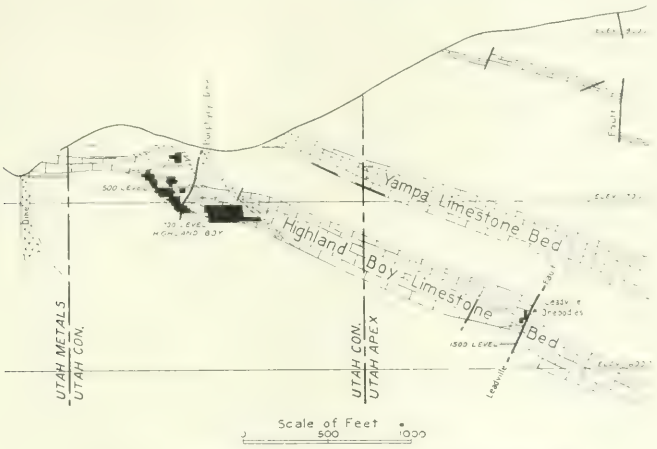


FIG. 1. GEOLOGIC SECTION SHOWING LEADVILLE OREBODIES

worked, they are now only from two to three hundred feet apart.

"The limestone found between these two limits—the wall of quartzite and the seam of clay or shale—has, at some period of the world's history, been subjected to some dynamic force of nature, by which it has been broken up, crushed, disintegrated, and fissured in all directions, so as to destroy, except in places of a few feet each, so far as explorations show, all traces of stratification; thus specially fitting it, according to the testimony of the men of science, to whom we have listened, for the reception of the mineral which, in ages past, came up from the depths below in solution, and was deposited in it. Evidence that the whole mass of limestone has been, at some period, lifted up and moved along the quartzite, is found in the marks of attrition engraved on the rock. This broken, crushed, and fissured condition pervades, to a greater or less extent, the whole body, showing that the same forces which operated upon a part, operated upon the whole, and at the same time. Wherever the quartzite is exposed, the marks of attrition appear. Below the quartzite no one has penetrated. Above the shale the rock has not been thus broken and crushed. Stratification exists there. If in some isolated places there is found evidence of disturbance, that disturbance has not been sufficient to affect the stratification. The broken, crushed, and fissured condition of the limestone gives it a specific individual character, by which it can be identified and separated from all other limestone in the vicinity.

"In this zone of limestone numerous caves or chambers are found, further distinguishing it from the neighboring rock. The limestone being broken and crushed up as stated, the water from above readily penetrated into it, and, operating as a solvent, formed these caves and chambers. No similar cavities are found in the rock beyond the shale, its hard and unbroken character not permitting, or at least opposing such action from the water above.

"Oxide of iron is also found in numerous places throughout the zone, giving to the miner assurance that the metal he seeks is in its vicinity.

"This broken, crushed, and fissured condition of the limestone, the presence of the oxides of iron, the caves or chambers we have mentioned, with the wall of quartzite and seam of clay bounding it, give to the zone, in the eyes of the practical miner, an individuality, a oneness as complete as that which the most perfect lode in a geological sense ever possessed. Each of the characteristics named, though produced at a different period from the others, was undoubtedly caused by the same forces operating at the same time upon the whole body of the limestone.

"Throughout this zone of limestone, as we have already stated, mineral is found in the numerous fissures of the rock."

Then after discussing the opinions of the expert witnesses he concludes:

"Our judgment being that the limestone zone in Ruby Hill, in Eureka district, lying between the quartzite and the shale, constitutes, within the meaning of the acts of Congress, one lode of rock-bearing metal, we proceed to consider the rights conveyed to the parties by their respective patents from the United States."

* * * * *

It is evident that the Eureka company claimed that the limestone constituted one lode, upon facts substantially as the court states them to be in the opinion. On the other hand, it is evident the Richmond company maintained that the ores found in the limestone constituted several lodes. It is stated in the opinion that:

"According to the opinions of all the scientific men who have been examined, this mineral was brought up in solution from the depths of the earth below, and would therefore naturally be very irregularly deposited in the fissures of the crushed matter, as these fissures are in every variety of form and size, and would also find its way in minute particles in the loose material of the rock."

It is stated that the expert witnesses called by the Eureka company all gave it as their opinion that the limestone constituted a vein or lode in the sense in which those terms are used by miners, and the language of Dr. Hunt, one of the witnesses for plaintiff, is quoted with evident approval in the opinion:

"That this whole mass of rock is impregnated with ore; that although the great mass of ore stretches for a long distance above horizontally and along an incline down the foot-wall, as I have traced it, from this deposit you can also trace the ore into a succession of great cavities or bonanzas lying irregularly across the limestone and into smaller caverns or chasms of the same sort; and that the whole mass of the limestone is irregularly impregnated with the ore. I use the word 'impregnation' in the sense that it has penetrated here and there; little patches and stains, ore-vugs and caverns and spaces of all sizes and all shapes, irregularly disseminated through the mass. I conclude, therefore, that this great mass of ore is, in the proper sense of the word, a great 'lode', or a great 'vein', in the sense in which the word is used by miners; and that practically the only way of utilizing this deposit, is to treat the whole of it as one great ore-bearing lode or mass of rock."

* * * * *

Summarizing the facts found by the Court in the Eureka case: There was a wedge-shaped zone of limestone dipping into the mountain for a distance slightly exceeding a mile lying between quartzite and shale beds which at the east end of the zone approach so closely as to be separated by a bare seam less than an inch in width. From that point they diverged until on the surface in the Eureka mine they were about 500 ft. apart, and on the surface in the Richmond mine about 800 ft. In this limestone zone at different places throughout its length and in various forms, mineral was found, sometimes in a series or succession of orebodies more or less closely connected, sometimes in what would seem to be scattered grains. This limestone zone was broken up, crushed, disintegrated, and fissured in all directions so as to de-

stroy, except in places of a few feet each, so far as exploration showed, all traces of stratification.

Evidence that the whole mass of limestone had been at some period lifted up and moved along the quartzite was found in the marks of attrition engraved on the rock. This broken, crushed, and fissured condition pervaded, to a greater or less extent, the whole body, showing that the same forces which operated upon a part operated upon the whole at the same time.

The broken, crushed, and fissured condition of the limestone gave it a specific, individual character by which it could be identified and separated from all other limestone in the vicinity. In the zone of limestone numerous caves or chambers were found, further distinguishing it from the neighboring rock. The limestone being broken up and crushed, as stated, the water from above readily penetrated into it and, operating as a solvent, formed these caves and chambers. No similar cavities were found in this case. In the Eureka case there were not two orebodies separated by a quarter of a mile of comparatively unbroken, unchanged, and unmineralized limestone, one of them upon a fissure, if not a true fissure-vein, as in the Leadville orebody in this case. Nor was there an intrusion of porphyry from below practically inclosing one of the orebodies on the hanging-wall side, as in this case.

In view of the facts in the Eureka case and the issues made by the parties, it is not astonishing that Judge Sawyer, who sat in the Eureka case with Justice Field, in the Mount Diablo case, 17 Fed. Cas. (No. 9886) 918, said:

"It never was intended in that case (the Eureka case) to hold that every metalliferous zone of country, to which boundaries could be found, must be regarded as one vein or lode, for this would be to reduce all mining districts to one lode."

I conclude, therefore, that the Eureka case is authority

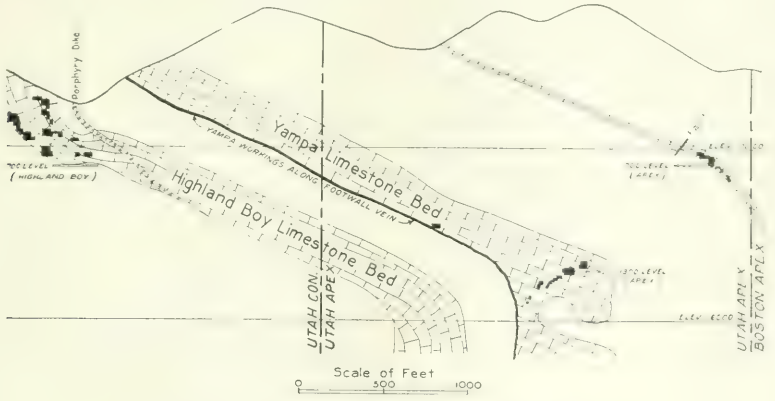


FIG. 2. GEOLOGIC SECTION SHOWING YAMPA OREBODIES

in the rock beyond the shale, its hard and unbroken character not permitting, or at least opposing such action from the water above.

Oxide of iron was also found in numerous places throughout the zone, giving to the miner assurance that the metal he sought was in its vicinity.

This broken, crushed, and fissured condition of the limestone, the presence of the oxides of iron, the caves or chambers, the wall of quartzite and seam of clay bounding it, gave to the zone, in the eyes of the practical miner, an individuality, a oneness as complete as that which the most perfect lode, in a geological sense, ever possessed. Each of the characteristics named, though produced at a different period from the others, was undoubtedly caused by the same forces operating at the same time upon the whole body of the limestone.

Throughout this zone of limestone mineral was found in the numerous fissures of the rock.

The facts which distinguish the case at bar from the Eureka case are so numerous and distinctive that I have no hesitancy in saying that the decision of the Court in the Eureka case upon the facts there found to exist cannot be held to be controlling under the facts as they exist for finding that the upper orebody found in the Highland Boy limestone, developed on its plunge and rake in the limestone, is a lode or vein within the meaning of the statute. Authority requiring the inclusion of the Leadville orebody and the intervening limestone in this upper lode, or justifying the calling of the entire Highland Boy limestone a lode, must be found in some other case.

The case of United States Mining Company v. Lawson, 134 Federal, 769, decided by the Circuit Court of Appeals of this circuit, is confidently relied upon by counsel for the defendant as such a case.

The orebodies which were the subject of litigation in the Lawson case were found in a body of limestone called the Jordan limestone, separated only a few thousand feet from the Highland Boy limestone, and as the Jordan limestone and the Highland Boy limestone are undoubtedly a part of the same sedimentary bed, uplifted at the same time, and possibly mineralized from the same mass or similar masses of porphyry lying below, it is encumbent upon me to give the decision of the case by the Circuit Court of Appeals most thoughtful consideration.

Counsel for the defendant have urged that I should

read and consider the record in that case in connection with the opinion of the Court. I have read the briefs in the Lawson case, filed in the Supreme Court of the United States, which contain more or less extended excerpts of the testimony of various witnesses of the parties. It is only fair to say, however, that I did not read the briefs for the purpose of forming an opinion upon the merits of the case but to learn the theory held by the respective parties as to the law applicable to the case, and to learn what each claimed the evidence proved.

Justice Van Dervanter has admirably stated the contentions of the parties in his statement of the case in the following language:

"The evidence was chiefly directed to the question whether or not the stratum of limestone constitutes a single broad vein or lode of mineral-bearing rock. Complainant insisted, and its evidence tended to show, that this stratum is such a single vein or lode, while the defendants insisted, and their evidence tended to show, that the stratum embraces several distinct and independent veins or lodes; that one such vein or lode, called a 'bedded vein', has its apex within the surface lines of the Kempton, extends on its strike in the direction of the Kempton end-lines, passes on its dip beneath the surface beyond the northerly side-line of that claim, and through the Jordan Extension, Ashland, Northern Light, Grizzly, and Fairview; that another distinct and independent vein or lode, called the 'Ashland cross-fissure', and of which the bedded vein is claimed to be a lateral continuation or appendage, has its apex in the Ashland, passes on its dip beneath the surface beyond the northwesterly side-line of that claim, and through the Northern Light, Grizzly, and Fairview, and that the orebodies in controversy are parts of the two veins or lodes, the apices of which are within the Kempton and Ashland."

From the foregoing statement it is seen that the evidence introduced by the defendants tended to show that the limestone embraced two distinct veins or lodes, namely, the Kempton vein and the Ashland cross-fissure, while in the Eureka case the evidence of the defendant, the Richmond company, did not tend to show the existence of one or more distinct or independent veins or lodes, but was directed to what the defendant and its witnesses defined to be or not to be a vein or lode. The decision of the Eureka case upon the admitted facts, was a question of law; the decision in the Lawson case one of fact.

The Court in the body of the opinion in the Lawson case says:

"A careful examination and consideration of the evidence clearly convinces us that the stratum of limestone constitutes a single broad vein or lode of mineral-bearing rock extending from the quartzite on one side to the quartzite on the other. The limestone has been profoundly broken, altered, and mineralized, and has thereby obtained an individuality, which, apart from other differences, clearly distinguishes it from the neighboring rock. There is a local absence of ore in places, a continuous occurrence of it in others, and a seeming local occurrence of it in still others, but the orebodies are not separated, one from another, by any definite boundaries. As in Eureka Consolidated Mining Co. v. Richmond Mining Co., 8 Fed. Cas. 819, 825 (No. 4548), they are parts of one greater deposit, which permeates, in a greater or less degree, with occasional intervening spaces of barren rock, the whole mass of limestone. As shown by extensive exploration and actual mining, the mineralization has been so general that its only defined limits are the quartzite walls which bound the limestone and within it one may reasonable expect to encounter ore by driving or cross-cutting in any direction.

"In addition to the many small fissures which exist only in the limestone and extend in every direction, other ore-bearing fissures of approximately a northerly and southerly direction are found in the quartzite, and it is the contention of the defendants that these extend through the limestone, and that its mineralization is due to them and occurred at the same time and in the same manner as did the deposition of the ore in them, and that the orebodies in the limestone are lateral continuations or appendages of these cross-fissure veins. Of this it is sufficient to say that, whatever may have been the mineralizing process, the alteration and mineralization of the limestone were so general and extensive as to convert it into a single broad vein or lode within which the cross-fissure veins are without defined boundaries, and so far lose their identity that they cannot be distinguished from the larger orebodies therein. The ore in the quartzite is inconsiderable in amount, and is confined to these fissure-veins, but it is not so in the limestone. In the evidence for the defendants it is conceded that there are no walls separating the cross-fissures from the bodies of ore in the limestone; but it is attempted to be shown that the ore in the fissures, and especially in the Ashland fissure, is distinguishable because its lamination conforms to the strike and dip of the fissure, while the lamination of the ore on either side conforms to the strike and dip of the limestone. We think the evidence for the defendants, as well as that for the complainant, shows that the difference in the lamination is not always discernible, and is an uncertain and unreliable test of the extent and boundaries of the cross-fissures. To illustrate, Mr. Wall, one of the defendants, says the plating of the ore in the limestone is similar in appearance to that of the ore in the fissure where the orebodies are large and wide, but a considerable distance from the fissure the structural lines become distinct and parallel to the bedding of the limestone. Mr. Legg, a witness for the defendants, says there is no sharp line of division, and the fissure structure and the influence of the fissure extend for considerable distances from the original fissure. Mr. Neill, another of the defendant's witnesses, says the fissure is entirely destroyed in places within the orebodies in the limestone. Mr. Moorehouse, also a witness for the defendants, says the Ashland fissure has a width in the quartzite of not exceeding three feet, and, when measured by the difference in the lamination of the ore,

has a width in the limestone of 180 ft. The defendants lay much stress upon the testimony of Mr. Holden, a witness for the complainant, who says: 'The Ashland vein can be followed for quite a distance into the Big Jordan (limestone) lode, and can be traced. It is like all of these fissures; it is somewhat difficult to follow through, but the way we do trace them we get a line from the quartzite on either side, or from one quartzite wall, and follow that line out, but we can't always find the limits of the fissure, which we take to be one of the cross-fissures.'

"This is far short of a statement that the boundaries of the Ashland, or of any other fissure, are well defined within the orebodies in the limestone. Particularly is this true when the entire testimony of the witness is considered, because he also says much of the limestone has been mechanically and chemically altered until the entire original stratification or bed structure has disappeared. Our conclusion upon this controverted question of fact is that the orebodies within the claimed spaces of intersection created by the cross-fissures, including the Ashland, are not susceptible of identification and separation from those in the stratum of limestone, and must be held to be parts of the single broad vein or lode and not parts of distinct and independent cross-fissure veins."

It is readily seen that the facts stated by the Court as above quoted do not run parallel to the facts in the case at bar. Here we have two orebodies, one a broad lode practically inclosed by a sheet and fingers of intruded porphyry, separated from the second orebody located upon a fissure as much as a fourth of a mile distant, with a mass of comparatively unbroken, unchanged, and unmineralized limestone intervening between them. Here there is no question of the ore found in one body extending into, overlapping, or joining with the ore of the other. While the ore extends for a considerable distance at places away from the Leadville fissure, the great mass of intervening limestone separates it from any of the orebodies of the broad lode above.

In the Lawson case the Court concludes its statement of the facts in the following language:

"Our conclusion upon this controverted question of fact is that the orebodies within the claimed spaces of intersection created by the cross-fissures, including the Ashland, are not susceptible of identification and separation from those in the stratum of limestone, and must be held to be parts of the single broad vein or lode, and not parts of distinct and independent cross-fissure veins."

In the case at bar there is no question of spaces of intersection between the broad lode above and the Leadville orebody below, created by cross-fissures or otherwise, and hence there is no question of identification and separation of the ores or orebodies found in the upper lode from the ore or orebodies found in the Leadville, and hence in this case the reason given in the quoted paragraph above does not exist upon which it was held in the Lawson case that all the ores found in the limestone were parts of a single broad vein or lode and not parts of distinct and independent cross-fissure veins.

* * * * *

In the case at bar we cannot say that the whole of the Highland Boy limestone has been profoundly broken, altered, and mineralized, and has thereby obtained an individuality which, apart from other differences, clearly distinguishes it from the neighboring rock.

On the contrary, in this case we have a large body of limestone lying between the two orebodies, comparatively unbroken, unaltered, and unmineralized.

In this case we cannot say, as was found by the Court in the Lawson case, that the orebodies are not separated, one from another, by any defined boundaries. On the contrary, in this case the orebodies are separated by the inclosing porphyry sheet and fingers and by the barren, unmineralized, and comparatively unbroken and unaltered limestone.

It has not been shown by extensive exploration or actual mining in the Highland Boy limestone that the mineralization has been so general that its only defined limits are the quartzite walls which bound the limestone, or that within it one may reasonably expect to encounter ore by driving or cross-cutting in any direction, as was found by the Court in the Lawson case. There has been only a limited exploration and no actual mining in the great mass of limestone lying between the two orebodies in the Highland Boy limestone. This limited exploration shows no mineralization above, and but slight mineralization below. If this condition of the limestone continues throughout its mass, the miner would not encounter ore by driving or cross-cutting in any part of it, whatever his expectations might be.

* * * * *

It cannot be said in this case that the ores of the Leadville orebody lose their identity, or that they cannot be distinguished from the orebodies found in the Highland Boy limestone above, as was found by the Court in the Lawson case to be the condition with respect to ores claimed by the defendants to belong to the Ashland fissure.

It was conceded in the Lawson case that there were no walls separating the cross-fissures from the bodies of ore in the limestone. In this case it is insisted with great earnestness that the porphyry sheet and fingers and intervening limestone constituted a definite, certain, and well-defined boundary separating the two orebodies.

On the other hand, in the Lawson case many of the facts are the same as, or similar to, the facts in this case. The orebodies which were the subject of litigation in the Lawson case were located only a few thousand feet from the orebodies which are the subject of litigation in this case. The Jordan limestone and the Highland Boy limestone are parts of the same sedimentary bed, and each lies between the same underlying and overlying quartzite. The sedimentary beds were subjected to the same forces by which they were uplifted and more or less tilted and bent as we now find them. In both, the sedimentary beds have been more or less broken and penetrated by masses of porphyry ascending from the deep. In both, the predominating minerals are copper and lead, found mainly

in the limestone, deposited there by replacement from solutions coming up from the masses of porphyry beneath. In the Lawson case the Court found the whole of the Jordan limestone to constitute one broad lode. In this case it is admitted that the upper segment of the Highland Boy limestone constitutes one broad lode. In both the Jordan and the Highland Boy limestones and the quartzite and other limestone beds lying above, are found numerous faults and fissures, some of them, as the Ashland in the Jordan and the Leadville in the Highland Boy, containing mineral. Except as heretofore noted, in both the limestone is similarly broken, altered, and mineralized.

The expert witnesses called by the defendant gave it as their opinion that the Highland Boy limestone intervening between the upper orebodies and the Leadville orebody may be prospected by the miner with reasonable expectation of finding ore by cross-cutting in any direction. It is the opinion of these witnesses that the Highland Boy limestone is one broad lode.

The expert witnesses for the plaintiff gave it as their opinion that the upper orebody below and south of the intruded sheet and fingers of porphyry is a broad lode, and that these porphyry intrusions constitute its northern boundary. It is the opinion of these witnesses that the Leadville orebody is a distinct entity, and that the intervening limestone is unmineralized and barren, and constitutes no part of either the upper lode or the Leadville orebody.

The experts called by the respective parties and who have testified in this case are men of great learning as geologists and of wide experience as mining engineers. I do not question the sincerity of any one of them. The opinion of each group commands attention and respectful consideration. So evenly are they balanced in learning and in experience that it would be difficult to determine on which side is the greater weight of the evidence, if it was not for the existence of an undisputed fact in the case confirming the opinion of the expert witnesses called by the plaintiff.

The witnesses for the defendant testified that this intervening limestone was ground in which the miner might reasonably expect to encounter ore by driving or cross-cutting in any direction. As stated by counsel of the defendant in their brief, for more than twenty years this property has been operated by the defendant and its predecessors, during which time there has been taken from the mine ore of the approximate value of forty million dollars. Notwithstanding such immense resources the defendant has failed, except to the limited extent heretofore indicated, to prospect this limestone or develop it.

I cannot escape the conviction that if there was reasonable expectation of finding ore by driving or cross-cutting in any direction in this limestone, the defendant, as a practical miner, at the time it ran tunnels and drifts through this intervening limestone, or since, would have cross-cut the limestone, and that it would have extended some of the many short drifts and cross-cuts now terminating along the upper and lower edges of this undeveloped country.

The barren limestone lying between the upper lode and the Leadville orebody breaks the continuity of the lode, and the question of the exact identity of wall or boundary is unimportant. "In the existence of such body and to the extent of it", as stated by Judge Hallett in the Cheesman case, 116 U. S. 536, language approved by the Supreme Court of the United States, "boundaries are implied".

I am of opinion that the broad lode apexing within the mining claims of the defendant does not include within it the intervening barren limestone or the Leadville orebody.

Judgment will be entered for the plaintiff.

'Missed Holes' is the subject of a recent pamphlet from the U. S. Bureau of Mines. The following is a summary of measures recommended for the purpose of minimizing this danger.

1. Only unfrozen explosives should be used. Explosives should be inspected to observe that they have not deteriorated by improper storage or age.

2. As a means of making more sure the detonation of explosives, a high-grade detonator, never less than number six, should be used.

3. After a hole has been prepared to receive the charge, it should be left until it is time to blast. Then, and only then, should the hole be loaded and fired.

4. In tamping, care should be taken not to injure the fuse or electric wires. If an electric detonator is used, precaution should be taken to prevent permanent short-circuiting or open-circuiting of the firing circuit.

5. Only wooden tamping-bars should be used. Metal tamping-bars injure the fuse and legs of detonators more readily than wooden ones. Metal tamping-bars are more likely to cause premature explosions from friction or sparks.

6. In firing a series of holes electrically, the circuit should be tested with a galvanometer before connecting to the blasting-machine. Such testing should be made at a safe distance from the explosive charge.

7. Leading-wires with broken insulation should not be used.

8. A blasting-machine of adequate capacity should be used.

9. Only good-quality fuse should be used. The detonator should be attached to the fuse with a cap-crimper. The cap-crimper should be in first-class condition.

10. In the preparation of primers, the electric detonator should be imbedded in the cartridge and secured firmly in place so that it cannot become separated from the explosive. If fuse is used with a detonator, the fuse should not be imbedded in the cartridge, but secured firmly in place.

11. Misfires occur in wet holes by reason of the lack of water-proofing between the fuse and detonator. It is customary to waterproof by means of yellow soap or such patented composition as Cap-Seal or Sealakap.

The Divining Rod

By WILLIAM PRYCE

*Hooson says, that "the first inventor of the Virgula Divinatoria was hanged in Germany as a cheat and impostor:" on the other hand, Dr. Diederick Wessel Linden says, in answer to him, that "Dr. Stahl, when he was "president of a chemical society in his country, published "a reward of twenty-five ducats for anybody that could "prove who was the inventor of the Virgula Divina-"toria." It is impossible to ascertain the date or personality of this discovery, which appears to me of very little consequence to posterity: but perhaps we may not be far off from the truth, if we incline to the opinion of Georgius Agricola, in his excellent Latin treatise 'De Re Metallica', that "the application of the inchanted or "divining rod to metallick matters, took its rise from "magicians, and the impure fountains of inchantment." Now the ancients not only endeavoured to procure the necessaries of life by a divining or inchanted rod, but also to change the form of things by the same instrument: for the magicians of Egypt, as we learn from the Hebrew writings, changed their rods into serpents; and, in Homer, Minerva turned Ulysses when old into the likeness of a young man, and again to his former appearance: Circe also changed the companions of Ulysses into beasts, and again restored them to the human shape; and Mercury, with his rod called Caduceus, gave sleep to the wakeful, and awakened those that were asleep. And hence, in all probability, arose the application of the forked rod to the discovery of hidden treasure.

Nevertheless we find no mention made of this Virgula before the eleventh century, since which it has been in frequent use. It was much talked of in France towards the end of the seventeenth century; and the corpuscular philosophy was called in to account for it. The corpuscles, it was said, that rise from the Minerals, entering the rod, determine it to bow down, in order to render it parallel to the vertical lines which the effluvia describe in their rise. In effect the Mineral particles seem to be emitted from the earth: now the Virgula being of a light porous wood, gives an easy passage to those particles, which are very fine and subtle; the effluvia then driven forwards by those that follow them, and pressed at the same time by the atmosphere incumbent on them, are forced to enter the little interstices between the fibres of the wood, and by that effort they oblige it to incline, or dip down perpendicularly, to become parallel with the little columns which those vapours form in their rise.

Now there are, first, many bodies, that in diverse cases act not, unless they be acted on! and some of them act, either solely or chiefly as they are acted on by common and unheeded agents. Secondly, there are certain subtle bodies that are ready to insinuate themselves into the pores of any body disposed to admit their action, or by some other way effect it. Thirdly, there are bodies, which, by a mechanical change of texture, may acquire or lose a fitness to be wrought upon by such unnoticed agents, and also to diversify their operations on it, upon the force of its varying texture. All these propositions are proved from the most common, though unheeded affairs and occurrencies of human life; as easily as the polarity and magnetism of an old Iron bar taken from a church window, where it has stood upright for many centuries, is proved to derive its virtue from the magnetick effluvia of the earth.

As many deny, or at least doubt, the attributed properties of the divining rod, I shall not take upon me, singly to oppose the general opinion, although I am well convinced of its absolute and improveable virtues. It does not become me to decide upon so controvertible a point; particularly, as from my natural constitution of mind and body, I am almost incapable of co-operating with its influence; and, therefore, cannot, of my own knowledge and experience, produce satisfactory proofs of its value and excellence. I shall, however, give those accurate observations on the virtues of the Virgula Divinatoria, which I have been favoured with by my worthy friend Mr. William Cookworthy, of Plymouth, a man, not less esteemed for his refined sense and unimpeachable veracity, than for his chemical abilities.

His first knowledge of the rod, he says, was from a captain Ribeira, who deserted the Spanish service in Queen Ann's reign, and became the capt. commandant in the garrison of Plymouth; in which town he satisfied several intelligent persons of the virtues of the rod by many experiments on pieces of Metal hid in the earth, and by the actual discovery of a Copper Mine near Oakhampton, which was wrought for some years. The captain made no difficulty to let people see him use the rod, but he was absolutely tenacious of the secret how to distinguish the different Metals by it, without which, the knowledge of its attraction is of little use: but by a close attention to his practice, the writer has discovered this, and made many other discoveries of its properties, which he is willing should be published, being fully persuaded of the great utility of this instrument in Mineral undertakings; and the reader may be assured, that he is fully convinced of the truth of what he communicates from abundant and very clear experience.

Captain Ribeira held, that rods cut from the nut or other fruit-bearing trees, were the only proper ones for this use: and that the virtue was confined to certain persons, and those comparatively few. Agricola says, "If "the attractive power of veins does not turn the rod,

*From 'Mineralogia Cornubiensis', published in 1778. The old style and spelling have been retained.

"when in the hands of some particular metallists or "others, it is owing to some singular occult quality in "the holder, which impedes and restrains the attractive "power; for since that power moves and turns the rod, "in the same manner as the Lodestone invites and at-"tracts Iron, it is debilitated and destroyed by the occult "quality in the holder, just as garlick weakens and ex-"cludes the attractive quality of the magnet, for a mag-"net rubbed over with juice of garlick does not draw Iron." But this proves to be a mistake of captain Ribeira; for the virtue, as he calls it, resides in all persons, and in all rods, under the circumstances hereafter described.

The rod is attracted by all the Metals, by Coals, Bones, Limestone, and Springs of Water, with different degrees of strength in the following order: 1 Gold, 2 Copper, 3 Iron, 4 Silver, 5 Tin, 6 Lead, 7 Coals, 8 Limestone and Springs of Water. One method to determine the different attractions of the rod, is this: Stand, holding the rod, with one foot advanced; put a guinea under that foot, and a halfpenny under the other, and the rod will be drawn down; shift the pieces of money, and the rod will then be drawn towards the face or backwards to the Gold, which proves the Gold to have the stronger attraction. By trying all the subjects of the rod in the same manner, their respective attractions in point of strength will be found to correspond with the order in which I have already placed them.

The rods formerly used, were shoots of one year's growth that grew forked, as figures 1 and 2, plate 1; but it is found, that two separate shoots tied together with some vegetable substance, as packthread, will answer rather better than those which are grown forked, as their shoots being seldom of equal length or bigness they do not handle so well as the others, which may be chosen of exactly the same size. The shape of the rod thus prepared, will be between 2½ and 3 feet long, like fig. 3, plate 1. They must be tied together at their great or root ends, the smaller being to be held in the hands. Hazle rods cut in the winter, such as are used for fishing rods, and kept till they are dry, do best; though where these are not at hand, apple-tree suckers, rods, from peach-trees, currants, or the oak, though green, will answer tolerably well.

It is very difficult to describe the manner of holding and using the rod: it ought to be held in the hands, in the position fig. 4, plate 1, the smaller ends lying flat or parallel to the horizon, and the upper part in an elevation not perpendicular to it, but 70 degrees.

The rod being properly held by those with whom it will answer, when the toe of the right foot is within the semi-diameter of the piece of Metal or other subject of the rod, it will be repelled towards the face, and continue to be so, while the foot is kept from touching or being directly over the subject; in which case, it will be sensibly and strongly attracted, and be drawn quite down. The rod should be firmly and steadily grasped; for if, when it hath begun to be attracted there be the least imaginable jerk, or opposition to its attraction, it will not move any more, till the hands are opened and a fresh grasp taken. The stronger the grasp the livelier the rod moves, provided the grasp be steady, and of an equal strength. This observation is very necessary, as the operation of the rod in many hands is defeated purely by a jerk or counter action; and it is from thence concluded, there is no real efficacy in the rod, or that the person who hold it wants the virtue; whereas by a proper attention to this circumstance in using it, five persons in six have the virtue as it is called; that is, the nut or fruit bearing rod will answer in their hands. When the rod is drawn down, the hands must be opened, the rod raised by the middle fingers, a fresh grasp taken, and the rod held again in the direction described.

A little practice by a person in earnest about it, will soon give him the necessary adroitness in the use of this instrument: but it must be particularly observed, that as our animal spirits are necessary to this process, so a man ought to hold the rod, with the same indifference and inattention to, or reasoning about it or its effects, as he holds a fishing rod or a walking stick; for if the mind be occupied by doubts, reasoning, or any other operation that engages the animal spirits, it will divert their powers from being exerted in this process, in which their instrumentality is absolutely necessary; from hence it is, that the rod constantly answers in the hands of peasants, women, and children, who hold it simply without puzzling their minds with doubts or reasonings. Whatever may be thought of this observation, it is a very just one, and of great consequence in the practice of the rod.

All rods, in all hands, answer to springs of water.

A piece of Gold held in the hand, and touching the rod, will not only hinder its being attracted by this Metal; but, on the contrary, the rod will be repelled towards the face. It is the same in regard to Copper as well as Gold, if the latter is held in the hand.

On these properties of the rod, depends the practice of distinguishing one Metal or subject from another. There is, however, another way of distinguishing, drawn from the same principles, but much more certain and ready than the former; and that is by preparing rods, that will only operate on Gold and Copper, Iron, the white Metals, Coals, Bones, and Limestone.

Thus, if a rod is wanted for distinguishing Copper or Gold, procure filings of Iron, Lead, and Tin, some leaf Silver, Chalk in powder, Coal in powder, and rasped bones: let a hole be bored with a small gimlet in the top of the rod; then mix the least imaginable quantity of the above ingredients, and put it in the gimlet hole with a peg of the same wood with the rod, when it will only be attracted by what is left out, viz. Gold and Copper.

In preparing a rod for distinguishing the white Metals, leave out the Lead, Tin, and leaf Silver, and add Copper filings to the other ingredients; and so of every subject by which you would have the rod attracted, the respective filings, or powder, must be left out of the mixture, which is to be put into the hole, at the top of the rod. As for Coal and Bones, they may be omitted in the distinguishing rods that are used in Cornwall, for obvious reasons:

but it is necessary to put in the Chalk or Lime: for though there is no Limestone in the Mining part of the county, yet there are abundance of strata that draw the rod as Limestone; for the distinction of a dead or a live course, holds as well in regard to Limestone, as to the Metals. This, however paradoxical it may appear, is a truth easily to be proved; and it is one axiom in the science of the rod, that it makes no distinction between the living and dead parts of a course. Like the Lodestone, it only shews the course, leaving the success of the undertaking, to the fortune, skill, and management of the Miner; as the Lodestone doth that of the voyage, to the fortune, ability, and prudence of the mariner and merchant.

It is advisable for young beginners to make no experiments but about actual Lodes, where the backs of them are known by the Miners; or else nigh the sea, where a Lode being discovered, they may trace it to the cliffs, and will be sure to find it.

In the course of tracing a Lode, all the circumstances of it, so far as they relate to its back, will be discovered; as its breadth at different places, its being squeezed together by hard strata, its being cut off and thrown aside from its regular course by a Cross-Gossan, &c.

In order to determine this, it will be necessary, that some one present should either cut up a turf, or place a stone at the places where the rod began, and on the other side where it ceased to be attracted.

The draughts, in plate 1, of Veins parted and proved according to the above directions, may make this sufficiently clear. The dots represent the turf or stone; and the zig zag, the line in which the operator moves in pursuing the Vein. Fig. 5, is a Lode going on east and west regularly, with the repulsion expressed by the lines north and south on each side. Fig. 6, is a Lode squeezed by a hard strata in some places almost to a string.

If the rod is well held, its motion is surprisingly quick and lively: nothing is necessary, but to keep the mind indifferent, to grasp the rod pretty strongly, and steadily; opening the hands, and raising the rod with the middle fingers, every time it is drawn down. If the rod is raised and replaced without opening the hands, it will not work.

The discovery of the Metal a Lode is naturally disposed to contain, is very easy: try it with a distinguishing rod; if it attracts it, it contains the Metal that is left out of the mixture at the top of that rod; if it draws more than one rod, the Lode is compounded of those Metals.

Copper Lodes generally draw the rod distinguishing Iron, because of the ferruginous Gossan contained in them; but Tin Lodes frequently draw none but their proper rod, unless Gal, which is a kind of Iron Ore, is intermixed.

If the Lode is alive to its top, or as it is usually phrased by the Tinners, To Grass; more work may be done in the way of discovery with the rod in a quarter of an hour, than by the usual methods in months, as a person has nothing to do, but to open the Lode immediately at grass, and discover its size and underlie, which may be done at a trifling expence.

The discovery of Cross-Gossans by the rod, is a property which may be usefully employed in Mining, particularly in driving adits, as the driving an adit through a Cross-Gossan is much easier than through the country.

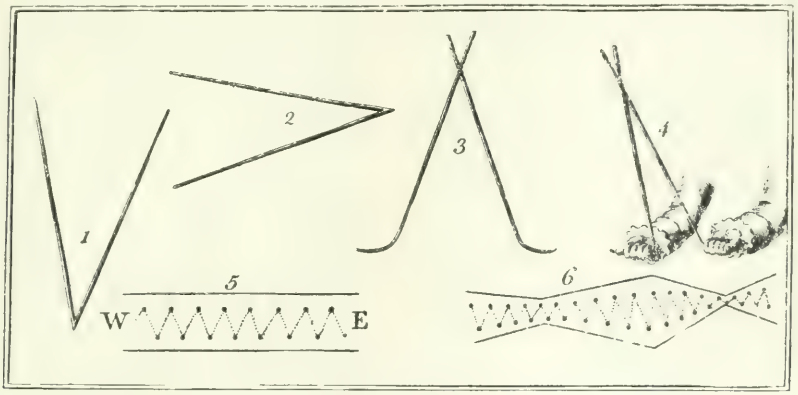


PLATE 1

In seeking for water by the rod, no notice is to be taken of those single attractions of the rod which are occasioned by the commissures or crevices (called Cases of Water by the Tinners) between the courses or distinct runs of Killas; but a vein must be found, which answers to the rod as a Metal, and if this is sunk unto a proper depth, a good quantity of water will be discovered.

It may not be amiss to close this little essay on the Virgula Divinatoria, with some few striking instances of courses, that have been cut by means of it in Cornwall.

A quantity of grain Tin having been found in the pond at Heligan, the seat of the reverend Mr. Henry Hawkins Tremayne; and it being a question, whether this Tin might not come from some neighbouring Lode, it was discovered by the rod and sunk upon; but it proved a barren Vein for Metal in any quantity. A shaft was sunk at St. Germains, near the house of Francis Fox, to discover water; it drew the rod as Iron, and contained Mundick: another shaft was sunk between Penzance and Newlyn, according to the direction of the rod; the fast lay deep

beneath the surface, but a Lode containing much Mundick was discovered. In a close just by St. Austle, to satisfy the curiosity of some gentlemen, Mr. Cookworthy discovered by the rod the back of a Lode that had been wrought, but not turning to advantage the undertaking had been dropped, and the ground levelled. This Lode was traced just as the Miners informed the gentlemen it ran; and the Lode appearing by the rod at a certain place to be squeezed to nothing, the Miners declared this also to be true; for at this very spot where the Lode was thus squeezed, they lost it. Being required to discover a Lode that had been tried in the cliff under St. Austle Down, he found it in the country by the rod, and traced it to the cliff. It was a large Gossan-Lode; and as the attraction was found to stop, and after passing on a foot or two to begin again, he declared this was a cleft Lode, and had what the Miners call a Horse in it, which the Miners present who had wrought in it declared to be true.

Hence it is very obvious, how useful the rod may be for discovery of Lodes, in the hands of an adept in that science; but it is remarkable, that although it inclines to all Metals in the hands of unskilful persons, and to some more quick and lively than to others, yet it has been found to dip equally to a poor Lode, and to a rich one. I know that a grain of Metal attracts the Virgula, as strongly as a pound; nor is this any disadvantage in its use in Mining: for if it discovered only rich Mines, or the richer parts of a Mine, the great prizes in the Mining Lottery would be soon drawn, and future adventurers would be discouraged from trying their fortune. But indeed, we are so plentifully stored with Tin and Copper Lodes, that some accident every week discovers to us a fresh Vein; rich Mines having been several times discovered by children playing, and digging pits in imitation of shafts, whereby profits have arisen to their parents and others; and these puerile discoveries have in sundry places borne the name of Huel-Boys to this day.

The Mexican Peon

"In the annual report of the Mexican Petroleum Company it is stated: The commencement of development gave us our first introduction to the Mexican laborer, generally known as the peon; and let me say here, in contradiction of all that has heretofore been said or may be said hereafter, that the Mexican peon is, and has been from the beginning, for us, a most satisfactory employee. He performs his task whether in the cold drizzly weather of the northern season, or under the full glare of the tropical noonday sun, with as much fortitude and more good humor than the average laborer of any class known to the American employer. Even in the latter part of April and during the first half of May of the present year, when the feeling against Americans ran high in all parts of Mexico, and especially near Tampico, and in the State of Vera Cruz, when it was deemed necessary that all Americans should withdraw from that part of Mexico (on account of the Mayo-Huerta incident at Tampico), which they did, and left the property of the oil companies of great value scattered throughout a wide region entirely at the mercy of a people with whom it seemed probable our people might soon be at war, the natural fidelity of the Mexican employee and his friendliness toward your company which had been a friend to him, was amply demonstrated by the care with which he conserved the property left in his charge. Except for the appropriation of horses, mules, automobiles, auto-trucks, cattle, etc., as necessary war measures by both armies, no damage was done or permitted to be done to any of your company's properties. The provisions of every sort, store supplies, small hardware supplies, and many other valuable and easily removable articles were entirely unmolested. No act of vandalism was perpetrated against the oil-reservoirs, pipe-lines, pumping machinery, or refineries. The product of your continuously flowing wells was so faithfully conserved by the Mexican employees in charge that your General Manager was able to report that not more than 5000 barrels of oil were lost during the thirty days absence of your American employees from the properties.

Upon their return to the property, they were welcomed by the Mexicans in charge as returning friends, not as whilom enemies. The business of the company was resumed as before the hegira of the Americans and your company's offices recognize that the company and its stockholders owe a debt of gratitude to these particular individual employees, and that the Mexican working people are entitled to more respect and confidence than had heretofore been positively known.

A statement was also made by one of the officers connected with the United States Smelting, Refining & Mining Company: "It has been by privilege to be connected with a mining company operating in Mexico. About ten years ago we went there. We have tried to treat the Mexicans as human beings. This attitude brought out the best there was in those people and the best there was in us. For eight and a half years of revolution under those southern stars the roar of our mills has never stopped. Today 7000 men operate them, of whom 57 only are Americans (less than 1%). After Vera Cruz we insisted that all our Americans leave Mexico. The properties were left in absolute charge of Mexicans for eight months. They stole nothing; they allowed no one else to steal anything; they operated the plants successfully, and returned them to us in as good condition as when the Americans went out.

"On another occasion $250,000 in bullion was stolen from the company. Our 6000 miners of their own notion, when they heard of this, saw to it that the bullion was returned within 24 hours, and within 48 hours it was on a Ward liner bound for Liverpool. Do you wonder that I trust them?"

During the first nine months of 1920 domestic production of crude oil increased 50,000,000 bbl. compared with the first nine months of 1919, while imports increased 30,000,000 bbl. This record indicates that production plus imports in 1920 will exceed 525,000,000 barrels.

*From the 'Stanford Illustrated Review', October 1920.

The Copperopolis Fire

We have received a letter from the Director of the U. S. Bureau of Mines, enclosing a letter from B. O. Pickard, district mining engineer of the Bureau, with headquarters at Berkeley, in which he demurs to our statement, in our news columns, that "the rescue-trucks arrived too late" at the scene of the fire in the mine of the Calaveras Consolidated Copper Co., at Copperopolis, California. We publish a letter from Mr. Pickard to D. J. Parker, Mine Safety Engineer of the Bureau; this letter carries conviction on the face of it, and also shows how prompt he and other members of the Bureau staff were in furnishing aid to the management at the mine. Dr. Cottrell, the Director of the Bureau, also sends us copies of warnings issued by the Bureau early last year in regard to the insufficiency of the Army mask as a protector against gases. We quote:

"The Army Gas Mask never should be used in mines, because of the uncertainty there is of the kinds and amounts of gases in the atmosphere."

Again, "The Army Gas Mask is by no means the unusual protective appliance that it is popularly believed. It does NOT afford universal protection against all gases, nor can it ever be used safely in low oxygen atmospheres."

Mr. Pickard's letter follows.

Copperopolis, California,
October 6, 1920.

My dear Mr. Parker:

You will no doubt be interested in a short preliminary report of Bureau of Mines' activities at the Calaveras Copper Mine fire. Mr. Gardner is making a complete investigation of the fire and will report at a later date.

Gardner and I were at Reno in the late P.M. of September 30, waiting for a train to go to Tonopah, Nevada, when we received a long-distance call from Hecox on Car One at Tonopah, advising the receipt of a wire from Wolflin to me of a fire at Copperopolis. We ordered the car and crew to take the first train out of Tonopah and left on the first train going west to Sacramento; arrived at Sacramento at 3:00 A.M., where we were met by a previously engaged automobile and drove some 96 miles to Copperopolis, arriving at the mine 8:00 P.M. Friday, October 1st. We found that Cooke had broken down with the Berkeley truck eight miles out of Copperopolis and had walked to the mine, beating us there.

The underground fire was caused by a fire on surface, all of the buildings in the vicinity of the downcast air shaft were burned down and the fire was transmitted to the head frame, which burned and fell into the shaft, igniting the shaft timbers. The smoke and gases were drawn into the mine. The fire started about midnight, September 29th, and the night shift was immediately drawn out of the mine. The next forenoon the foreman seemed anxious to have a certain air valve turned on in order that the air from the compressor would clear out the gases from the main up-cast shaft, so that the pumps could be operated. A miner by the name of Lamson was standing near by and remarked that he had a gas mask which he had used in the army, and that it was good for any kind of gas, and he would wear it and go down and turn on this valve. The foreman tried to persuade him not to go down, but Lamson was allowed to go down in the skip. As he did not return within the 15 minutes agreed upon, the foreman became alarmed, put on a dust respirator, and with another man (Kingsberry) who also put on a respirator, went down in the skip to rescue Lamson. After reaching the lower level they started down the ladder into the sump in search of Lamson, the foreman being last on the ladder. The foreman felt that he was being affected with the gas and called to Kingsberry to come up; he did not reply; immediately after the foreman heard a crash, and decided that Kingsberry had fallen down the ladder. The foreman had just enough strength in reserve to climb the ladder to the skip, and give the hoisting signal. Upon reaching the surface he was completely unconscious and was revived by rubbing and artificial respiration. The mine breathing apparatus had been burned in the fire and there had been no mine training in apparatus for a couple of years.

As soon as Mr. Gardner and I arrived we tried to ascertain the number of apparatus men available and found that there were three who might be competent in case of an emergency. Mr. Kelsey, Manager of the Argonaut Mine, was present and volunteered to do his part. We therefore organized a crew with Gardner as Captain, Cooke, Kelsey, Gregory, Chief Mining Engineer of the property, and Post, one of the Company men, who went down to the bottom of the mine to ascertain if there was any chance of the two men in the mine being alive, although no hope was held out for them. This crew went down at 4:50 P.M. October 1st, and thoroughly satisfied themselves that both men had been gassed and fallen off the ladders into the sump. Other explorations were made to start and repair pumps.

On Saturday October 2nd, at 4:30 P.M., Hecox, Donovan, and McLaughlin arrived with car apparatus and oxygen pump. At 6:20, two four-men crews went into the mine to recover the bodies. Gardner was captain of number one crew and Cooke captain of number two crew. I took charge of surface and reserve crew. McLaughlin and Hecox were on crew number one and Donovan was on crew number two, the balance of the crews' personnel were company men. Grappling hooks were used to pull the two bodies out of seven feet of water at the bottom of the 1300 foot shaft. When found Lamson had his gas mask in place and Kingsberry his respirator over his mouth. Both had fallen off the ladders and their necks were broken. At 7:33, the two bodies were brought to the surface and delivered to the coroner.

The principal purpose of this description is to call your attention to the splendid work which was done by your men. I cannot say enough for the work of Gardner, Cooke, Hecox, Donovan and McLaughlin. They proved themselves to be *real* Bureau of Mines' Rescue men, and you need never have any doubt about their actions in an emergency. Cooke drove the truck all night and broke

down about 8 miles away from the mine. He walked in to the mine, took an automobile back to the truck and brought in the apparatus and supplies, and then wanted to know what else there was for him to do. This was about 11:00 A.M. We sent him to bed to get a little sleep before going underground. His actions underground warranted us in making him captain of the second recovery crew. If he out-shined the other Bureau men, it was because they did not have the opportunities.

Gardner was always on the job "using his head", and he proved himself to be the right man in an emergency. Hecox is a natural leader of apparatus men, and demonstrated his thorough knowledge of the apparatus. Donovan and McLaughlin kept cool and worked hard and faithfully. In fact, I am very proud of the way all the men handled themselves at this fire, as it was the first fire for most of them.

My recent telegrams will give you an idea of future plans. Fighting the fire is going to be quite a problem, and I have insisted that the mine company furnish crews for the job. As the present time Hecox is training some 10 to 12 men of questionable ability, and I have suggested that the mining company hire apparatus men from the Grass Valley and other neighboring companies.

Car One will leave tomorrow for the Globe Safety Meet, leaving Hecox and Cooke to train the men, and to keep an eye on the fire. Daily trips down the main shaft to start the pumps will be necessary. This will be done with Bureau of Mines' apparatus, with Cooke and Hecox alternating as captains. I am leaving for Berkeley today, to take care of some urgent work, but will return to the property within a week.

If this information does not suffice, until Gardner turns in his final report, please wire me at Berkeley.

Very truly yours,

B. O. Pickard.

Milling Talc

A brief description of the mill of the Uniform Fibrous Talc Co. of Taleville, New York, appears in a recent report issued by the U. S. Bureau of Mines. The ore-skip is dumped automatically in a chute leading to a picking-floor at the top of the 'rock-house'. Here waste is sorted out, thrown into a chute leading to a waste-car and trammed to the dump. The ore is shoveled into a chute leading to a 150-ton rock-bin. At the bottom of the bin large lumps are broken down with sledges and the ore is fed by shovel into a 10 by 16-in. jaw-crusher. A set of 14 by 24-in. rolls, set at ½ in., followed by a trommel, which returns the pieces that will not pass a ½-in. hole, and two 8-ft. pebble-mills in series comprise the crushing equipment.

This plant is perhaps typical of the talc-plants, using intermittent lump-cylinders, or short pebble-mills. The cylinders are of steel 6 ft. in diameter by 8 ft. long, and are lined with porcelain brick. A charge consisting of ore [illegible] and three tons of flint pebbles is revolved at 22½ r.p.m. for a period of four to seven hours. The grinding period is determined by visual inspection of the product. When the grinding is completed the charging door is removed, a grating to hold back the pebbles placed over the opening, and the mill revolved until the talc all flows out into a hopper beneath. At the bottom of each hopper, which serves two mills in parallel, is a screw-conveyor which transfers the talc to an elevator, and thence to a 16-mesh revolving screen. This screen is intended to remove broken pebbles, sticks, and coarse impurities. It is estimated that 80% of the finished product is packed in 50-lb. paper sacks.

Chromiferous Iron Ore

Extensive deposits of chromiferous iron ore occur near the north coast of Cuba in Oriente and Camaguey provinces. The principal areas in which they are found are the Mayari district, 12 miles south of Nipe bay, the Moa district, about 50 miles east of Nipe bay, both in Oriente province, and the Cubitas district, 15 miles north of the Camaguey, in the Province of the same name. The deposits occur as lateritic mantles overlying serpentine and are spread over many square miles of plateaus, flat-topped ridges, and gentle mountain slopes, according to E. F. Burchard in 'Mineral Resources'. The ore is hydrous iron oxide, chiefly in the form of ferruginous yellow clay, with a top layer of spongy limonite and small hard pellets of limonite. The thickness of the deposits varies, the pellet, or 'shot', ore generally not exceeding a few feet, but the ferruginous clay is in places more than 50 ft. deep. The percentage of chromium present is generally small, but fairly constant, and serves to distinguish the ore as chromiferous as compared with the bulk of the brown iron ore mined in the southern Appalachian region of the United States. Locally, deposits contain abnormal percentages of chromium, such portions probably representing residual accumulations from broken-down bodies of chromite. Nickel is present also in the ore, but to a less extent than chromium. The Mayari district is the only one in which mining operations are carried on. Here, after careful study, successful large-scale methods were developed for mining, handling, and transporting the raw ore from the plateau down to Nipe bay, where it is subjected to treatment which not only dries the clay-like material but produces incipient fusion, or nodulization. The ore lies on a plateau about 1700 ft. above sea-level. It is mined from open-pits by drag-line excavators. The roasting and nodulizing are carried on in large rotary kilns, heated by pulverized coal and identical with those used in the manufacture of portland cement. The raw ore as mined in 1918 carried about 1.5% chromium and between 0.5 and 1% of nickel. In nodulizing the greater part of the water is driven off and the proportions of the metallic constituents are increased so that the chromium rises to about 2%. Both the chromium and nickel contents are utilized in making 'Mayari' steel, in which 1.3 to 1.5% of nickel and 0.3 to 0.5% of chromium are present. The ore is used chiefly in the Sparrows Point, Maryland, and Steelton, Pennsylvania, plants of the Bethlehem Steel Company.

The Food-Draft System of the American Relief Administration

By EDGAR RICKARD

When the American Relief Administration came to an end as a government-sustained organization and the American Relief Administration European Children's Fund was formed, we decided to limit our appeals for funds in the United States to the nationals of those countries where the after-war suffering demanded relief. We felt that to the residents of America who had emigrated here from Central and Eastern Europe must have been coming by every mail and passenger steamer such poignant stories of the mother-land's need for food that response would prove automatic.

Our first effort, therefore, was to organize among the affected nationals definite collecting agencies. We learned immediately that the appeals from Europe, on which we had counted to inspire giving, caused one other unmistakable reaction. There developed from the beginning coldness toward and even opposition to the idea of bulk-feeding. The Teuton or the Slav or the Jew in the United States was not primarily stirred by mass sympathy for his country or his race. The call was more delicately keyed than that. On his heart lay, invariably, the needs and suffering of a particular family or a group of friends and former business associates. From these persons, warmly real and near through memories of love or companionship, had come accounts of individual want.

Needless to say, the unorganized effort to relieve from this side the destitution of individuals and families in Europe met with disappointment. The kindly disposed European in the United States who went to his corner grocery store, bought haphazard articles of food, packed them unskilfully, and started them hopefully toward the interior of the Old World continent, will ever remain a tragic figure. There were thousands of them. But transportation in Europe was so chaotic, morals and the sentiment against petty thievery so lax, that the food-consignees rarely received more than notice of shipment, or perhaps an empty box from which the contents had been looted.

I am going to pass over lightly (for it is a story in itself) the period between April 21 and June 30, 1919, during which, on a vast scale, for the first time in modern history, the American Relief Administration substituted food for gold as the vehicle of foreign exchange. In those ten weeks we negotiated food-credits totalling $8,500,000, keeping the gold of the needy governments on this side, where it could do them the most good, and accepting for the delivered food the currencies of Europe. By an order of the Federal Reserve Board, we were the exclusive agency empowered to exchange dollars into the currency of the newly-created governments. The break-down of relations between bankers in this country and Central and Eastern Europe had been utter; yet we were able to rehabilitate international banking relationships through the all-powerful medium of food.

The decision to institute the plan of Food Drafts that is now in operation was reached in November of 1919. In the three months following that decision not a wheel was turned on the task itself. Day by day, week by week, the directors met soberly, formulating the 'how' of the system and seeking to guarantee against failure when the machinery should be put in motion and endeavoring to make it simple and fool-proof.

Mr. Hoover's name and ability to present a great appeal secured the services of nearly 5000 banks as sales-agencies. The co-operation of the American Bankers' Association in the handling of Food Drafts should be triple-starred in the list of American charities. The very number of the co-operating banks, however, made certain limitations manifest. It would be impossible to issue frequent revisions of instructions to such an army of representatives. The packages of food for which the drafts were to be cashed in Europe would have to be simple and unvarying in content, although five nations and two classes of consumers, Christian and Jew, had to be served. And the price of the packages would have to remain unchanged for at least a year.

That necessity for stability of price presented a problem in economics that no theoretical process could have solved. Fortunately, Mr. Hoover had superintended the transportation of two billion dollars worth of food to Europe since the beginning of the War. It was possible from the practical starting-point of that performance to arrive at a definite overhead charge to cover expenses and risks involved. The only variable item was the fluctuating cost of the commodities, which was protected by an additional margin to be returned to the Children's Fund if not required to meet unexpected increase in food prices. At the end of our three months of machinery-building, we purchased in the open market, largely on credit, $6,000,000 worth of food, enough to protect the maximum number of Food Drafts, which at best could only be roughly approximated.

The perplexities and difficulties that beset us in those three preparatory months were almost infinite. For instance, about so unromantic a factor as the outer sacking of flour were centred vital questions. With flour, as with all our staples, we found it necessary to deal in the accepted commercial units of measurement. Something more was necessary than a dietician's word that the

food packages were made up in proper proportions of milk, flour, rice, beans, or bacon. We had to be sure that the packages could be made up readily from commercial units. In the case of the flour, it was to come in large sacks, each containing smaller 24½-lb. bags. To bring those large sacks back from Europe to America empty would have been costly. To pay for them and throw them away meant thousands of dollars loss in operations as large as we planned. To sell them for the depreciated currency of Europe would also mean loss. In the end, we had the outer sacking made of extra heavy quality, and once emptied of its smaller bags, used it as a container for the made-up Food Draft packages of food.

Another consideration that weighed heavily on every man who helped plan the Food Drafts was the tremendous impetus or setback that the quality of the food would inevitably give America's reputation in Europe. We shuddered lest some slip add to the European's fondness for the story about the Connecticut Yankee who sold wooden nutmegs. Incalculable harm had just been done the American manufacturer in the minds of the Germans, for example, by the flooding of Germany with bacon containing an excessive amount of preservative. This meat, treated according to Great Britain's orders for supplies when the English feared that submarine warfare might isolate them completely, was intended to remain edible at least three years. Consequently, it was barely edible when packed. The wide sale of this meat, marked 'American bacon', in Germany after the War, almost defeated the Food Draft plan in that country.

With the determination that every Food Draft package should be an international evidence of America's good faith and an advertisement of America's modern methods, we put our own inspectors into even the proudest packing houses in the country. And every form of foodstuff purchased had to undergo the same sort of uncompromising inspection. In our allowance for cost, we made provision for buying, in every instance, the highest quality of food obtainable on the market, and for inspecting even the Grade A product.

In order to protect ourselves against sharp changes in the food-market, it was necessary to put the Food Drafts on sale at a price that would leave a contingency margin. This we did, with the advertised provision that any unused portion of this margin, which would be called profit in a commercial enterprise, would be used to feed the needy children of the countries into which the Food Drafts went. In spite of the contingency allowance, the difference between the food-value purchased by the individual under our plan and what he can buy in any other way in the world, has become proverbial. We early had to institute the most stringent precautions to avoid the purchase of the Food Drafts for speculative purposes.

The putting of the plan into operation, its endorsement by the United States and European governments and scores of organizations, the actual sale of 180,000 drafts, and the delivery in Europe of $5,000,000 worth of food are virtually current history. It was no little satisfaction that the excess margin accruing under the plan up to August 1, 1920, a total of $605,194 was turned over to the governments of Austria, Hungary, Czecho-Slovakia, Poland, and Germany, for use by their branches of the European Children's Fund.

I believe that this winter will see a new figure set for Food Draft sales. Certainly the need is great. In the meantime, it can be said for all the men who planned the venture that no one in the world is more surprised than they at the scarcity of weak points that have come to light in the eye of eight months operation. The urge of the appalling suffering that the plan has helped and is helping to alleviate must have caused some Power to endow our scheming and working with success beyond our mental deserts. There was no chart in the sea of international finance and economics by which we could steer. We are more than happy, in plain language, to have 'got somewhere'.

CHROMIUM does not occur native but appears in about a dozen minerals in the form of oxides, chromates, sulphates, and silicates. Chromite, an oxide of chromium and iron, is practically the only commercial source of chromium. It is composed when pure of 68% of chromic oxide and 32% of ferrous oxide. In nature, however, some of the chromium in chromite is replaced by aluminum or iron. Much of the rich imported ore contains 50% or more of chromic oxide, but the average American ore contains only about 40%. Chromite is a common constituent of basic igneous rocks, especially of peridotite, which is composed largely or wholly of olivine or pyroxene. As rocks composed of olivine and pyroxene readily alter to serpentine and the chromite in them remains unchanged, the most common occurrence of chromite is in crystalline grains widely distributed in serpentine. Chromite is used for making alloys, chemical compounds, and refractory materials. The most important alloy is with iron in ferro-chromium used in making chrome steel, which is remarkable for its hardness in resisting wear and penetration. Its principal application is in armor plates and shells for piercing them, as well as in special parts of aeroplanes, automobiles, and engines, and in stellite for high-speed cutting tools and parts of other machinery. Chrome-steel is extremely hard, tough, and dense. It possesses great tensile strength and is superior to any other metal known for the wearing parts of mills used in crushing. Chrome-steel, though hard, bends well cold if the operation is slow enough. It can be welded to iron and rolled out and finds use in sheet metal and rod metal, especially as material for burglar-proof safes, wire, magnet-steel, cutlery, bridge-steel, tires, axles, springs, stamp-mill shoes and dies, crusher-jaws, knuckles for car-couplings, lathe tools, drills, and chisels. The steel for shoes and dies for stamp-mills if compressed hot in a hydraulic forging press removes internal porosity and renders the steel of equal density and wear-resistance throughout.

Of 170 of State Public Service Commissions only six are members of a National Engineering Society.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

COLORADO

RICH LEAD ORE FOUND IN THE ARIADNE MINE AT SAN JUAN.

Central City.—A new body of rich copper-silver-gold ore is reported opened in the Evergreen mine at Apex. A large tonnage of milling ore is broken and awaits improvement in copper prices. The mill in the meantime is not operating. Development work continues at the Saco De Oro property at Apex where the Barrick tunnel vein has recently been opened by the shaft.

Durango.—Operations will be continued this winter on the Ten Broeck, Lewis mountain, by the Lewis Mining & Milling Co. as a result of the recent discovery of a new five-foot orebody assaying from $12 to $25 per ton in gold and silver. The property is situated seven miles from La Plata city. Operations at the Esmeralda on the south fork of the Lightner and at the Jumbo mine near Mayday have been discontinued for the winter. Heavy snow storms have begun already.

Georgetown.—The Sunburst company, financed by Eastern capital will continue operations on its Democrat Mountain property this winter. A large compressor has been ordered and development on Astor-Stewart mines will be pushed as soon as the plant is in operation. The Georgetown Tunnel Co. has shut-down its mill and is driving the big 'bore' to its objective under the old producing mines of Democrat mountain.

Idaho Springs.—The Walder group adjoining the Reynolds at Alice has been taken over by the Roosevelt company. There are eight claims in the Walder group that with little development have produced ore of good grade. Additional equipment including another battery of stamps is being added to the mill and a compressor is being installed. The Shafter mine is again to be operated. A force is now engaged cleaning up and re-timbering old workings. The Shafter has a record for production of high-grade gold ore worth several millions. A bond and lease on the Gum Tree, presumed to have the extension of the Freeland vein, has been secured by Lee Gibson and associates of Idaho Springs. The mine has excellent prospects. Lead-silver-gold ore assaying as high as 186 oz. silver, 0.5 oz. gold, and 4% lead has been opened by a local leasing pool on the Ship Ahoy. The Silver Age lessees are producing and shipping a good grade of ore. Chicago capital has become interested in the Specie Payment and preparations are being made to start development.

Leadville.—The proposed 'Home' mining company is reported to be eliciting the support of citizens and a meeting is scheduled to name an executive committee to select a desirable property for operation. Increased production will result from the increased operating force secued for the L. & M. lease on the A. Y. and Minnie. The Bartell lease on this property is mining and shipping silver-lead ore at the rate of about a car per week. The ore nets close to $1000 per car. Chrysolite lessees have opened up a rich silver-lead vein averaging 40% lead and 11 to 16 oz. silver and are shipping steadily. A local company has been organized to operate the Gold Leaf adjoining the Emma and Mabel mine. Machinery is being installed preparatory to sinking a deep shaft.

Silverton.—A 14-in. streak of lead-copper ore assaying better than $100 per ton has been opened up at the 650-ft. level of the Ariadne mine, in San Juan district, and with a week's development the ore has widened to two feet. The same vein is producing for the Ariadne Mining Co. in three levels above and the shaft is also in ore. Development will continue and ore will be stored during the winter. The construction of an aerial tram is planned for next spring. Work is continuing on the Eastern Star, where development in the tunnel is reported to be encouraging.

MICHIGAN

SHIPMENTS OF COPPER DURING OCTOBER.—DEVELOPMENTS AT ARCADIAN CONSOLIDATED.

Houghton.—October copper shipments by water totaled 8,322,000 lb. This is an increase of 1,648,000 lb. over September, but it is far below the normal for October, practically the last month of the year that shipping is without hazards. November tonnages usually are small. The total shipment down the lakes this year is 53,156,000 lb., compared with 49,596,000 in 1919. Heavy rail shipments in the late spring months bring the 1920 total considerably over that of last year and with a number of small mines closed, the end of 1920 should leave the producers with smaller stocks on hand than at the close of 1919.

Coal shipments this year have not fallen so far below the 1919 figures that any of the larger mines are in danger of a shortage. The combined cargoes shipped since May total 498,454 tons. A year ago, 621,686 tons of soft coal was shipped into the district, so in view of the general shortage during the summer the Lake Superior region has fared well. With the mines on a basis

varying from 50 to 60% of normal, these stocks of fuel should tide them over until the opening of navigation.

October 'rock' production figures reveal an improvement for Osceola, which reports 7000 tons for the month. This is an increase of 1325 over September. The Kearsarge branch also shows a betterment, with a tonnage of 37,700, against 35,550 in the preceding month. Ahmeek, on the other hand, dropped slightly from September, reporting 69,300 tons, compared with 73,050. On an estimated yield of 22.5 lb. to the ton, Ahmeek's refined copper output for October is 1,559,000 lb., or 50,000 below the total for September. Superior made no shipments during the month and no tonnage is reported by LaSalle.

Copper Range Consolidated this week started using a mechanical shovel that promises well. It is operated by one man, whose average is 24 tons of rock per day, whereas one shoveler removes but 10 or 12 tons of rock in an 8-hour shift. The Copper Range also is devising a shovel with a belt-conveyor for the purpose of sorting underground. Various mines in the district are experimenting with mechanical shovels and stope-scrapers, with some success. Owing to differences in size of openings, however, it is necessary for each mine to work out its own individual problems. A device that will work satisfactorily in one mine will not work in another and the difficulties peculiar to each property will result in a variety of devices.

Arcadian Consolidated, at a depth of 700 ft. in its New Baltic shaft, is in the vein and the showing is described as good. The characteristics are identical with those on the 400, 500, and 600-ft. levels and from appearances the mineralization is as good at the present depth as nearer surface. Instead of cutting a station at 700 ft. it is planned to continue to the 750-ft. point before a level is put in and there will be no intervening level between that and the 900-ft. station. While it has not been definitely announced whether operations will continue through the winter, in all probability there will be no delay in pushing the shaft down to the 900-ft. level. The identity of the New Baltic vein, as regards correlating it with lodes opened on other mines, has not been established and it may be that this particular orebody never was opened elsewhere for the reason that it is far to the east of Kearsarge amygdaloid. It is for this reason that the Arcadian developments are of interest to the mines to the north for it may be that the same lode will be found all along the range into Keweenaw. The fact that the New Baltic lode was not discovered by the early explorers is explained by the overburden of 60 ft. which was penetrated before the vein was tapped.

Hancock Consolidated has completed the construction of a concrete wall on its 53rd level and operations in the property have temporarily ceased. The wall, built to take care of surface-water flowing through drifts and in addition to protect Hancock's new openings, will prevent the water from flooding Quincy's openings in No. 7 shaft. Hancock does not plan to resume operations until the market is stabilized and the demand for copper is such that full-time operations are warranted. The territory east of the main Pewabic lode, chiefly on the 49th and 53rd levels, has been thoroughly developed. With present high costs for fuel, wages, and mining supplies, Hancock's management concluded to conserve resources rather than dip into the treasury to pay development expenses. Among the new openings that are regarded as highly favorable are those on No. 12 amygdaloid, which was opened in a cross-cut from the 44th level. No. 3 lode also disclosed fair ground. When Hancock decides to resume, the mine will be in fair condition to produce at once, save for minor repairs in the milling plant at Point Mills in which it holds an interest.

NEVADA

EXTENSION GRANTED ON INGALLS OPTION.

Tule Canyon.—W. A. Ingalls and W. B. Mercer, owners of the Ingalls mine, have extended six months the time for the second payment to be made by the Silver Hills, holder of the option, and have agreed to grant a further extension of six months if the Silver Hills requests it. It is understood that work is to be resumed immediately under this agreement, the entire effort of the company in the mine to be devoted to exploring the 200-ft. level. The mill, which the company started to dismantle, will be left standing and will be used for retreating the tailing made before cyanidation was started. Mercer says it is his opinion that the shaft passed far out of the vein between the 100 and 200-ft. levels and that the recent work has been done 70 ft. from the main ore-channel. It is understood there will be a complete change of management and Mercer is confident the work now planned will result in ore being found on the 200-ft., or bottom, level. The Silver Hills took over the Ingalls on February 12 of this year for $125,000, the payments to extend over two years. The option was signed after W. J. Loring had inspected the workings. The adjoining Jaeggers group of six claims was optioned for $20,000 at the same time. Ingalls has been owner or part owner of the mine for 30 years and what is reported to have been some of the richest silver-lead ore sent from the State was shipped over the Nevada & Califorina railroad to San Francisco 20 to 25 years ago. The production to date is estimated at $225,000 gross, made almost entirely by lessees.

Reno.—Work is to be resumed in the Standard Metals, a copper-silver-lead mine north of Reno, on November 1, according to A. L. Chappel, manager. No attempt will be made to operate the 60-ton concentration and flotation plant until spring and the winter will be devoted to further development of the mine on and below the third, or 215-ft., level, which is 500 ft. from the surface on the dip of the vein. There has been exposed on the upper levels an ore-shoots 150 ft. long and 10 to 50 ft. wide. This ore can be treated in the mill at a good profit, according to reports. The mill concentrates on Wilfley tables 60-mesh material, which is re-ground to 100-mesh and then treated in an 8-ft. K & K flotation machine. In test-runs made last summer with a concentration ratio of 11:1 by the combined processes the tables gave a $75 product and the

flotation machine a $200 product. The Standard Metals is three miles west of the Black Panther.

PIOCHE.—In a report to stockholders the directors of the Black Metal, operating a copper-silver-lead mine in the Jackrabbit district, 14 miles from Pioche, give the production as 17,602 tons of flux ore of a net value of $111,074. The report says: "Considering the large amount of ore shipped it would seem that a reasonable profit should have been realized instead of a loss. To those familiar with conditions in connection with the operation of a mine during the last year little explanation is necessary." Referring to the mining of a low-grade orebody under present conditions, the report continues: "Railroad tie-ups, car shortages, inefficient labor, and inability to get sufficient men to operate the mine at more than half capacity are the principal items that wiped out the profit of your company." Machinery cost $18,000 and the report, which says a financial statement is being prepared, indicates that there was a heavy expense for other equipment. An assessment of two cents per share has been levied.

It is stated that the Virginia Louise Mining Co. will increase its output immediately; a contract having been entered into with the American Smelting & Refining Co. for 50 tons of fluxing ore per day, in addition to the contract for 75 tons per day entered into some time ago with the United States Smelting Co. The shipments being made at present come from the 2nd, 3rd, and 5th level stopes. There are three principal beds of iron manganese in the mine. The upper, or Davidson, averages from 40 to 55 ft. in thickness and lies at the bottom of the limestone, where it comes in contact with a bed of shale about 100 ft. thick. Below this shale is the 'big bed', from 80 to 100 ft. thick. Under this is a paring of limestone, 15 to 20 ft. thick, below which is a 20-ft. bed of manganese. The Virginia Louise also has had a considerable amount of high-grade silver-lead ore, mixed with the fluxing ore, in the lower workings of the mine. During the week ending November 6, the Prince Consolidated shipped 1250 tons; Virginia Louise, 510; Bristol Silver, 100; Consolidated Nevada Utah, 175; and Ida-May property, 45; making a total of 2080 tons. Michael Kinsella and Owen Walker, who recently secured a lease on the Great Eastern mine, owned by the Bristol Silver Mines Co., have found ore averaging 12% copper and 50 oz. silver. A number of leases have recently been given by the Bristol company, and shipments are increasing in spite of the high freight-rates.

ELY.—The orebody recently opened on the 700-ft. level of the Nevada Consolidated proved to be 150 ft. long, 50 ft. wide, and it extends 60 ft. above the level, with an average copper content of 7%, according to C. B. Lakenan, general manager. "The body is at a contact of lime and porphyry, and a 10-ft. width next to the porphyry assays 12 to 18%. The orebody is a secondary enrichment of the pyritic mass on the limestone side of the contact, brought about by the precipitation of copper from migrating copper sulphate solutions," Mr. Lakenan says. He adds that the deposit "indicates other similar orebodies might be found around the lime-porphyry contact", and drilling has been been started from the surface in search for such ores. A drill also will be used on the 700-ft. level to explore the downward extension of the orebody recently found.

VIRGINIA CITY.—The Northern Light Comstock, incorporated last month to develop a claim adjoining the Concordia, will work through the 300-ft. level of the Concordia shaft, according to an announcement made after a meeting of the incorporators, R. L. Colburn, N. R. Harris, T. J. Pearce, A. D. Cunningham, and L. F. Grimstad, all of San Francisco.

CAMP AT STONEWALL, NEVADA

UTAH

MINERS ARE MORE PLENTIFUL IN PARK CITY AND EUREKA.—SILVER KING COALITION STARTS COMMISSARY FOR EMPLOYEES.

SALT LAKE CITY.—Carl A. Allen, State Inspector of Mines, has submitted to the Industrial Commission of Utah statistics covering the employees in metalliferous mines, mills, and smelters of this State during the past three years. During 1919, 4599 men were employed for an average of 325 days at underground and surface mines, as compared with 6901 in 1918 and 7937 in 1917. The concentrating mills employed an average of 1382 men during 1919, as compared with 1942 in 1918 and 4103 in 1917. The smelters employed an average of 1832 men in 1919, as against 3173 in 1918 and 2658 in 1917.

Auxiliary works employed an average of 709 men in 1919, 1885 in 1918, and 2811 in 1917. This makes the total number of men employed in the mining and treatment of ores 8522 during 1919, 13,901 during 1918, and 16,509 during 1917.

ALTA.—Considerable anxiety is being caused the officials of the Alta-Superior Mining Co. as to the whereabouts of Frank Tyler and Herbert Waterworth, who were doing work under contract at the property of the company, five miles from here. N. A. Nelson, secretary of the company, was at the property on October 6, and the men asked for a month's supply of provisions, which were sent to them on October 11. As no word had been received for a month, a party of three made the trip to the mine on skiis on November 10. No sign of the men was found, and not more than a two weeks supply of the food had been used. About 575 ft. from the mouth of the tunnel and about 50 ft. from the face, the searching party encountered a big cave of talc from the roof. It is feared that the men were entombed, or that they may have been caught in a snowslide, which for years has been the terror of this camp during the winter season. The snow at the Alta-Superior is about eight feet deep. Work was immediately started clearing the tunnel to ascertain if the men were entrapped by the cave.

PARK CITY.—The labor situation shows a marked improvement over the conditions obtaining during the past summer, and the larger mines are now gradually getting their forces up to normal, as well as increasing efficiency. During the week ending November 6, a total of 1843 tons was shipped, of which the Daly-West and Judge contributed 692; Silver King Coalition, 601; Ontario, 490; and Naildriver, 60. At the Keystone the management is directing its energies toward the development of ore and is making no attempts to stope. At present, two drifts and three raises are being run. In the face of K-K 3 tunnel, which is all in ore, assays indicate returns of 35% lead with 15 oz. silver. Sufficient supplies have been taken to the property to permit development throughout the winter. The Silver King Coalition Mines Co. is the latest mining company in Utah to supply groceries, fuel, and clothing to its employees at cost plus a small percentage for handling the goods. The company has purchased a coal-yard and other buildings necessary to carry out this plan. The company now has a larger payroll than it has had for the past six months. As fast as men are obtainable, they are being put on development work. On the 1100-ft. level the 'quartz' drift is being run to the south-west and the Blood drift to the north-east. Both drifts are coming through a lime formation, close to the contact.

BINGHAM.—A promising find was made recently at the Silver Shield property, according to F. L. Block, mining engineer of Salt Lake City. In a stope about 200 ft. from the present orebodies, 18 in. of ore averaging 30% lead, 10% iron, and 7 oz. silver has been uncovered. Mr. Block is of the opinion that the lime bed in which this ore occurs is the Jordan lime strata, which is one of the productive beds in the United States mine, adjoining the Silver Shield. During the early part of the year, mining men familiar with the district were of the opinion that the work being done by the Silver Shield company was too far into the mountain, whereupon efforts were directed toward the locality where the recent find was made.

EUREKA.—All of the mines in this district report an improvement in the labor situation, which is reflected in the heavier output during the week ending November 6, when 166 cars of ore were shipped. Of this number, the Chief Consolidated shipped 43; Tintic Standard, 45; Mammoth, 17; Dragon, 14; Eagle & Blue Bell, 13; Iron Blossom, 7; Iron King, 6; Grand Central, 4; Centennial-Eureka, 4; Gemini, 4; Victoria, 4; Swansea, 3; Eureka-Hill, 1; and Bullion Beck, 1. Shaft No. 2 at the Chief Consolidated property has passed the 1750-ft. level; the total footage sunk during October being 132. It is planned to sink the shaft to a depth of 1900 ft. For some time past, the shaft has been in a solid shale formation and the concreting of the last few hundred feet will be deferred until the sinking is finished, which it is expected will be accomplished by the end of the year.

As a result of the drop in price of copper and the expiration of its smelting contract, the Mammoth Mining Co. has suspended ore shipments, according to Earl McIntyre, manager. The mine force is being kept together and is engaged in development work. Shipments from the dump are being made, and Mr. McIntyre hopes that a new contract can be negotiated which will permit of shipments from the mine.

WISCONSIN

REVIEW FOR OCTOBER.

Depression in the zinc-mining and smelting industry, further accentuated during the month of October, was mainly responsible for a curtailed production at mines in the Wisconsin field, and a relative drop in the amount of high-grade blende marketed. The shutting-down of the American Metal Co.'s smelters in Arkansas narrowed the outlet for zinc ore; the buyer representing this concern locally withdrew at a time when the buying was the most constricted ever known to the field. The Mineral Point Zinc Co. had the field to itself almost entirely during the month, the only other smelter to be represented being the Illinois Zinc Co., at Peru, Illinois. However, the Mineral Point Zinc Co. did not turn the situation to its advantage, as offerings on zinc ore remained steady most of the month.

Lead ore received bad treatment at the hands of buyers, declines being rapid and sharp until the price dropped to $65 per ton, at which figure lead-ore producers no longer cared to market and shipments for the month were the lightest reported at any time during the year. The beginning of the decline found sellers expectant and much ore held in bin was carried along in the belief that a recovery in price would be a matter of a short period at most. These declines have been steady and at present there are about 2000 tons of lead ore in the field unmarketed. Producers of carbonate-zinc ore withdrew from the market some time ago.

The manufacture of sulphuric acid, which has become important in the Wisconsin field, has been carried on successfully at the National Separators at Cuba City, the production amounting to 40 tons per day. This product was for a time marketed in Chicago and Milwaukee, but recently it is claimed that the demand has not been so good and that a more determined effort to market became imperative. Shipments continue at the rate of one 25-ton tank-car daily with the acid department of the Mineral Point Zinc Co. shipping three or four such cars weekly.

Deliveries of zinc ore and lead ore from mines to refineries were made for October by districts as here shown.

District	Zinc, lb.	Lead, lb.
Benton	8,954,000	140,000
Livingston	6,736,000	160,000
Cuba City	2,108,000	60,000
Galena	1,828,000	.....
Day Siding	1,666,000	.....
Platteville	948,000	.....
Shullsburg	736,000	.....
Hazel Green	586,000	.....
Highland	150,000	.....
Total	23,712,000	360,000

Shipments of high-grade blende from refiners to smelter were made by the following concerns:

District	Lb.
Mineral Point Zinc Co	5,204,000
National Zinc Separators	4,080,000
Wisconsin Zinc Roasters	1,260,000
Linden Zinc Separators	478,000
Block-House Mining Co	468,000
Total	11,490,000

The gross recovery of milled ore for the month aggregated 11,566 tons, net to smelters, 5745; carbonate-zinc ore 45. The high-grade blende went to the Prime Western Smelters, 416 tons; Illinois Zinc Co., 726; American Metal Co., 498; Mineral Point Zinc Co., 4105 tons.

BRITISH COLUMBIA

NICKEL PLATE MINE SUSPENDS OPERATIONS.—REPORTS FROM THE PREMIER PROPERTY.

HEDLEY.—The Hedley Gold Mining Co. has closed the Nickel Plate mine, throwing 150 men out of employment. So far as the men are concerned, they hardly are deserving of sympathy, as, notwithstanding that they have been warned time and time again that it would be impossible to continue operations and pay increased wages, they have been insistent in their demands for increases. J. P. Jones, the general manager of the mine, has made the following announcement: "During the World War we continued operations at Hedley as we felt it to be our duty not only to British Columbia and to the Allies, as gold was needed, but also a moral obligation to the town of Hedley. After the Armistice we continued to operate, thinking all costs would come down and allow us to make a fair profit. We have been disappointed in this conclusion, and find that we cannot earn reasonable dividends under existing circumstances and maintain our ore-reserve. We have accordingly recommended to the board of directors that the property be closed down until conditions change. This will probably mean a shut-down of a year. The mine, mill, and other plant should be in good condition to start-up when conditions justify it." There has been a persistent rumor that the Consolidated M. & S. Co. had been negotiating for the purchase of the mine, but it is difficult to see what its object would be, unless it proposes to start the manufacture of germicides and needs the arsenic. Latterly the Nickel Plate has been producing $20,000 worth of arsenic yearly. There is another rumor that the Hedley company proposed to combine with a strong United States smelting company in the exploration of the Bradshaw and Nick-of-Time

INTERIOR OF A ZINC-MILL IN THE PLATTEVILLE DISTRICT, WISCONSIN

claims, north of Hedley. These claims are said to contain ore similar to the Nickel Plate, but with a higher arsenic content; the gold running about the same.

TRAIL.—During the last ten days of October, 12,125 tons of ore and concentrate was received at the smelter, the Consolidated company's mines contributing 11,230 tons. The other shippers were: Bluebell, Riondel, 185 tons; Emerald, Salmo, 38; Granby, Grand Forks, 91; Josie, Rossland, 228; Monarch, Field, 33; North Star, Kimberley, 159; Paradise, Athalmer, 35; Ruth, Ainsworth, 63; Skyline, Ainsworth, 55; and Waterloo, Edgewood, 8. The total ore received for the ten months ended October 31 was 296,662 tons. This is only about 30,000 tons less than was received during the whole of last year, so, if this rate of shipping keeps up until the end of the year, the total quantity of ore handled at the smelter should be considerably more than last year. Most of the ore during the present year has come from the Sullivan mine, consequently more zinc ore has been treated than any other kind.

STEWART.—H. A. Guess, of the American Smelting & Refining Co., spent the first few days of the month at the Premier mine, and he stated that he was entirely satisfied with the development of the mine, which fully has come up to expectations. An attempt has been made to start shipping before the snow covered the whole of the

road, but it was found to be unsatisfactory. One consignment of 50 tons went to Tacoma. It is expected that the snow will enable regular shipping to commence soon after the middle of November, and an attempt will be made to get at least 3000 tons of high-grade to the Tacoma smelter this winter. This will have a gold and silver content worth between $800,000 and $1,000,000. Two snow-tractors are now on their way to Stewart, and will be used in shipping ore this winter. These are said to have been thoroughly tested; the one tried last winter was an experiment and a failure. The new water-power plant is nearly finished, and will be in operation early in December. The concentrating and cyanide-plant should be finished early in the spring. It was expected that the plant would have been finished by the end of the year, but the severe rains that fell during last summer completely ruined the road from Stewart to the mine, and made the hauling of heavy machinery impossible. Much of the machinery for the plant is still on the wharf at Stewart. Bert F. Smith, of Hazelton, has been appointed assistant to Dale L. Pitt, manager of the mine.

W. A. Meloche, managing engineer for the Algunican Development Co., states that ore will be shipped this winter from the Spider mine, and that if the development planned shows a tonnage equal to three times what is in sight, a mill will be working on the property by next July.

VANCOUVER.—A clean-up of 50 gold bars valued at more than half a million dollars was made at the Dominion Government assay office and shipped to the mint at Ottawa. The staff at the mint report that the season, so far as gold mining is concerned, has been very unsatisfactory, both as regards British Columbia and the Yukon. The water-shortage interfered with placer operations at both places, and the closing of the Rossland mines, which essentially are gold mines, for a large part of the year has reduced the gold output of British Columbia markedly. The closing of the Nickel Plate mine will be a great blow to the lode-gold mining of the Province.

ANYOX.—The Hidden Creek mine of the Granby Consolidated Mining & Smelting Co. has 11,000,000 tons of ore designated as No. 1, containing 2.4% copper, and 14,000,000 tons designated as No. 2, containing about 1.25% copper, according to a recently published report. Direct smelting is said to be applicable to the No. 1 ore, but the No. 2 will become available after concentration.

NELSON.—The Ottawa mine is rapidly being put in shape for operation and shipment of ore. Machinery, including a tube-mill, is on the ground, and the cable for the tram is at the upper terminal, which has been finished. The latter will be about 2000 ft. long. L. H. Biggar, the mine manager, is satisfied with the progress made.

ONTARIO

MINERS MORE PLENTIFUL AT COBALT.

COBALT.—The labor supply at Cobalt is becoming more plentiful and efficiency has increased considerably during the few weeks. Operators believe it will be possible to reduce the per-ounce cost of producing silver and thereby make up for the reduced income caused by the lower quotations for the metal. The McKinley-Darragh has closed down its oil-flotation plant for the winter. The equipment will again be employed following the spring break-up. Ore in the Keeley silver mine is estimated to contain 400,000 oz. of silver. This has been placed in sight as a result of less than one year's development work. Other properties in the South Lorrain area, in the vicinity of the Keeley, are now attracting attention.

The Ontario Bureau of Mines has issued a detailed report on the geology and the output of silver from the Gowganda district. The report declares the rocks in Gowganda to resemble in a general way those at Cobalt. Production reached the highest point in 1917, amounting to 1,064,639 oz. The second highest record was in 1919 when 722,564 oz. was produced. In the ten years from 1910 to 1919, both years inclusive, the district produced 5,430,152 oz. In view of operations having continued steadily throughout the current year, the production to the end of 1920 is estimated as likely to reach 6,200,000 oz. Cobalt mine-operators believe the price of silver is going up. A large quantity of bullion is being held in store at the mines. The opening of the new year is expected to find quotations around $1 per ounce, or equal to the price being paid American producers under the terms of the Pittman Act.

SUDBURY.—It is officially announced that the output of the International Nickel Co. will be reduced from 4000 to 3000 tons of nickel matte per month, bringing production down to the pre-war basis. One furnace is being shut-down and the working force reduced by about 250 men. The cause assigned is business depression in the United States.

PORCUPINE.—The development of a large orebody on the McIntyre below the 1000-ft. level, paralleling the No. 5 vein, is regarded as of importance not only to the McIntyre but to the Hollinger Consolidated, as the deposit is ascertained to be a continuation of vein No. 84 of the Hollinger. So far as this deposit has been opened in the latter mine it is estimated to contain ore to the value of $6,282,620, this amount being chiefly above the 800-ft. level, and its continuance to the depth now reached on the McIntyre will greatly increase the ore-reserves of the Hollinger. Up to the present the Hollinger has developed 38 veins, and has 39 veins, which have not yet been opened for mining, outcropping on the surface.

The ore in sight on the Porcupine Vipond-North Thompson, including development work down to the 600-ft. level, is estimated at approximately 130,000 tons valued at $1,250,000. The company is planning to sink to the 900 or 1000-ft. level and open up main haulage levels, and to remodel and extend the 100-ton mill.

KIRKLAND LAKE.—The Moffatt-Hall which has 12 claims on Crystal Lake, Lebel township, has put up buildings and done preliminary work in stripping and test-pitting. Some of the orebodies have been proved to be large and to yield good assays. Funds have been raised for the resumption of operations.

ARIZONA

Ajo.—A ten-ton hoist has been installed at the Copper Ridge mine preparatory to sinking the present 30-ft. shaft to the 100-ft. level. From this point cross-cuts are to be run to several known veins from which 40% ore has been taken near the surface. Several shipments of high-grade ore have been made in the past. This property was formerly known as the Ajo Cornelia and adjoins the Ajo Consolidated claims of the New Cornelia on the east and south. Nearly all the stock of the company is held locally.

Kingman.—A larger force of men is being put to work at the Antler mine of the Newby Mines Co. A carload of ore is being shipped to the railroad at Yucca, two more cars being on the dump. It is reported that there is a considerable tonnage of 8% copper ore now developed which when dressed will yield a 20% concentrate. The lease was obtained on the property a year ago. The mine produced a large tonnage of ore years ago.——It is reported that a strike of high-grade silver ore has been made at the O'Fallon mine west of Cerbat. The ore is said to be 30 in. wide and assays 250 oz. per ton in silver. The mine is owned by the Jones brothers and is under option to Percy Allwyn, who is developing on the old levels. The mine has produced some high-grade silver-lead ore in the past.——The Big Four Metals Co. is making preparations for extensive development at the mine in the Wallapai mountains. A hoist and compressor have been ordered and the old road is to be repaired. The ore carries gold, silver, lead, and vanadium, the last running high. J. S. Garrison is in charge of the property.

Kayser brothers and Jackman, who are operating the Neptune mine, have driven a drift along the vein opening splendid ore. A carload of the ore is on the dump and is said to average 200 oz. per ton in silver. Grading and the cement foundations for the mill at the C. O. D. mine have been completed. The machinery for the mill is expected any day. The drift on the 400-ft. level has opened ore, specimens of which are very rich. Each foot of development work opens more ore. It is said that there is a year's supply of mill-ore now developed. C. P. Sherman is in charge of development work.

CALIFORNIA

Shasta County.—On the petition of the United States Smelting, Refining & Mining Co., the suit brought against it by the Shasta Copper Exploration Co. has been transferred by the Superior Court to the United States courts. Both companies are claiming the same mining ground in the neighborhood of Kennett.——In the Little Nellie mine near Iron Mountain a body of copper ore has been found in the new drift run from the bottom of the 500-ft. winze sunk recently, thus proving the contention of the company that what has always been a gold mine would prove to be a copper mine when developed in the direction of the Iron Mountain mine.——E. K. Kirkland of Weaverville and Sim Mack of San Francisco have taken a two-year option on the Washington mine near French Gulch and have set a crew of eight men at work.

Nevada County.—An aeroplane has made a test of the feasibility of serving a circuit of mines in this region with light supplies and mail. The plane made a circuit of approximately 60 miles over the mining region, landing just 51 minutes from the time of starting. The route included Morning Star, Iowa Hill, Birds' Flat, Little York, You Bet, Red Dog, Nevada City, and the Grass Valley district. Most of these places are off the railroad and on poor roads and it is estimated that it would require eight hours to reach them by automobile.

San Benito County.—The New Idria Quicksilver Mining Co. has announced that its mine will be closed down temporarily, owing to the stagnation of the metal market.

COLORADO

Denver.—The twenty-third annual convention of the American Mining Congress opened in this city on November 15, with delegates in attendance from all sections of the United States. Questions of importance to the mining industry were considered under nine general divisions, as follows:

1. Present-day relations between operator and employee; increased efficiency in production; wages, hours, working conditions, and contracts.
2. Tariffs pertaining to mine products and the uniformity of national and state mining laws.
3. The feasibility of holding a national conference on the standardization of mining machinery, and labor and life-saving devices.
4. The existing excess-profits tax law declared to be unfair to the mining industry.
5. The problem of the decline of the nation's gold production, and means of preventing further depletion of the nation's monetary reserve.
6. War-minerals.
7. Relief of claimants for compensation who, under existing technicalities of the law, are often denied relief.
8. The petroleum industry and the development of the vast oil-shale deposits in Colorado and other States.
9. National and local problems of the coal-mining industry.

IDAHO

Coeur d'Alene.—Activity is increasing in the silver belt lying along Big creek. The Yankee Boy mine, a steady contributor of high-grade ore, has shipped another carload said to assay $100 per ton. The Big Creek company is running dump-ore through the mill, producing a high-grade silver concentrate. The development of the mine is proceeding. The Sterling Silver Mountain company has purchased 10 claims adjoining the property on Big creek. The new claims are on the line of the vein being developed.——The Western is engaged in assessment work. The First National will cross-cut the vein in the lower tunnel. The Big Hill & Silverdale company is driving a cross-cut that has attained the 700-ft. point.——High-grade tungsten ore has been found in the property of the Kennon Mining Co. in the North Fork district. The ore was assayed to determine its gold content and the presence of tungsten was discovered. The tungsten ore is eight inches wide in a vein five feet wide. The ore contains $5 to $6 in gold.——The best ore yet found in the Ajax mine was cut recently, according to A. C. Bixby, manager. It is a full face of good milling ore in the east drift. The company some time ago sunk a shaft

200 ft. from the Moonlight vein and sunk a winze 120 ft. on the vein. From the bottom of the winze it drifted 150 ft. Most of this distance the tunnel followed a vein of good milling ore about a foot wide. As this vein did not change, the work was turned to an east drift where the full face of ore was found.——An assay certificate received recently by the Nabob Consolidated mine shows that the last carload of lead concentrate shipped contained 54% lead, 7% zinc, and 21 oz. of silver per ton. This is the highest recovery made in the mill. The car contained 40 tons and was produced since new equipment was installed.

Talache.—The Armstead Mines Co., whose property is on Lake Pend Oreille, is engaged in the development of a body of milling ore, according to H. H. Armstead, president. The principal content is silver.

MONTANA

Butte.—The Davis-Daly Copper Co. is producing approximately 1,000,000 lb. of copper per month. The company has just finished installing a new hoist and erecting new and modern buildings. This construction is being paid for from earnings, and costs at present are averaging between 13 and 14c. per pound. Shipping its ore to the East Butte smelter, which settles on receipts of shipment, Davis-Daly is not tying up cash in unsold copper. There is a discussion now going on between Anaconda and Davis-Daly relative to the apex rights to one of the latter's main veins. The former company intimated that it had ownership through apex rights to this particular vein and is now endeavoring to prove its allegations. Davis-Daly is awaiting the results of its big neighbor's findings.——The zinc-producing mines are curtailing production. Butte & Superior has reduced its output by 30%, and at Senator Clark's Elm Orlu mine a similar reduction has been made. A number of the Anaconda company's zinc mines have discontinued production entirely pending improvement in the market for zinc.

MANITOBA

The Pas.—The syndicate headed by W. B. Thompson, of New York, which holds an option on the Flin Flon copper deposit, has completed an arrangement with the Manitoba government under which a survey will be made for a railway to the mine. The Government did not feel inclined to undertake the cost involved until it had assurance that the syndicate would exercise its option. Not being able to give such assurance the syndicate proposed that the Government should proceed with the survey on its undertaking to pay the cost, including an estimate of the cost of constructing the railway, in case it failed to take up the option and develop the mine. This proposition was accepted, the cost being fixed at $15,000. The survey work will be done by the engineering department of the Canadian National Railways, and a report with reference to the cost of construction will be made for the Provincial government to present to the next session of the Manitoba legislature. The syndicate has spent $200,000 on the Flin Flon property and if the option is exercised must pay $1,000,000 on March 1.

Obituary

Chester A. Thomas, formerly manager for the American Smelters Securities Co., and a mining engineer of wide reputation, died at Dawson, Alaska, on November 11. He was in Alaska, re-visiting the scene of his early engineering career at the time of his death. For years he was in charge of the Guggenheim interests in Alaska, and later in California and Arizona. He left San Francisco last August. Shortly after his arrival at Dawson he suffered a breakdown in health. He is survived by a widow and three children, all of whom are residents of Berkeley.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Edwin E. Chase is at Butte on professional work.

O. Hondrum has left Cananea, Mexico, and is at Jerome, Arizona.

George D. Blood has moved from Salt Lake City to San Francisco.

Bond Coleman has moved from Mound City, Kansas, to Pachuca, Mexico.

T. A. Rickard is in Denver attending the meeting of the American Mining Congress.

Walter Fitch Jr., mining contractor of Eureka, Utah, has returned from a trip to Juneau, Alaska.

Duncan MacVichie, president of the Western Utah Copper Co. at Gold Hill, Utah, is at Los Angeles.

E. W. Engelmann, consulting research engineer for the Jackling porphyry interests, is in New York.

A. H. Lawrence has just returned to Santiago after spending several months in the wilds of Bolivia and Peru.

Henry N. Thomson has accepted the chair of metallurgy in the University of British Columbia at Vancouver.

T. M. Hamilton arrived on the 'Huron' on November 4, from Buenos Aires, and will reside at Lewistown, Montana.

Arthur H. Carpenter has become assistant professor of metallurgy at the Armour Institute of Technology, Chicago.

Frederick Lyon, formerly vice-president of the U. S. Smelting Co., has been visiting the company's properties in Utah.

August Grunert, mining engineer of Butte, has been making an examination of the Tungsten Comet mine, near Pioche, Nevada.

H. Foster Bain, Marshall D. Draper, and **T. K. Li,** having finished their work in Yunnan, China, are returning to the United States.

George E. Drewitt has concluded his mining report for the financial house of Jose I. Lazama, Havana, Cuba, and will sail for Spain and England.

G. A. Overstrom is visiting the properties of the Seoul Mining Co., in Japan and Korea. He will not return to this country until the first of the year.

M. W. von Bernewitz has re-joined **W. H. Weed** in compiling the 'Mines Handbook', whose office is now at Tuckahoe, 16 miles north of New York city.

Walter Hovey Hill has been in the East for the past month, and is now at Stanley, Idaho, as consulting engineer to the United Metals & Power Corporation.

George Crerar has joined the working force of the El Fuerte Mining & Smelting Co., at Choix, Sinaloa, Mexico, and will have charge of the installation and operation of the copper blast-furnace.

Arthur W. Burgren, assistant superintendent of the Dolores mine at Matehuala, Mexico, is at Knights Ferry, California, convalescing from a recent illness. He expects to return to Mexico in a month.

Jerome A. Hilbert has resigned his position as superintendent of the Blue Ledge mine, at Copper, California, to become superintendent of the Cia. Metalurgica Mexicana, at Sierro Mojada, Coahuila, Mexico.

Herbert Hoover, Theodore Hoover, James M. Hyde, David McClure, and **H. W. Turner** will, after December 1, have offices in the new Balfour building. Herbert Hoover will retain an office in the Mills building as well.

Albert L. Waters, having just finished a two years engagement, is continuing as mining engineer and general superintendent for all the mining interests of Charles E. Richardson & Co. in the province of Kwangtun, south China, with headquarters at Swatow.

THE METAL MARKET

METAL PRICES

San Francisco, November 16

Aluminum-dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	16.50—17.00
Lead, pig, cents per pound	7.25—8.25
Platinum, pure, per ounce	$85
Platinum, 10% iridium per ounce	$125
Quicksilver, per flask of 75 lb	$55
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

November 15.—Copper is quiet and steadier. Lead is dull and lower. Zinc is inactive but easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Nov. 9	80.75	53.75	Oct. 4	91.65	58.98
" 10	82.25	54.62	" 11	86.77	55.66
" 11	80.87	54.12	" 18	83.10	54.05
" 12	80.37	53.87	" 25	79.52	52.31
" 13	79.37	53.25	Nov. 1	80.31	52.35
" 14 Sunday			" 8	81.90	54.00
" 15	76.50	51.37	" 15	80.02	53.50

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	93.66
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	83.48
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Nov. 9	15.00	Oct. 4	18.50
" 10	15.00	" 11	17.85
" 11	14.75	" 18	17.15
" 12	14.75	" 25	15.75
" 13	14.75	Nov. 1	15.08
" 14 Sunday		" 8	15.00
" 15	15.00	" 15	14.87

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.15	18.75
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	16.53
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Nov. 9	6.70	Oct. 4	7.54
" 10	6.70	" 11	7.50
" 11	6.70	" 18	7.50
" 12	6.55	" 25	7.08
" 13	6.50	Nov. 1	6.92
" 14 Sunday		" 8	6.84
" 15	6.50	" 15	6.61

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	8.08
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	7.28
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	82.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	44.43
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	40.47
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Nov. 9	7.25	Oct. 4	7.66
" 10	7.10	" 11	7.55
" 11	7.00	" 18	7.41
" 12	6.80	" 25	7.50
" 13	6.80	Nov. 1	7.54
" 14 Sunday		" 8	7.31
" 15	6.80	" 15	6.86

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	7.84
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	7.50
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Nov.	
Oct. 19	70.00	1	60.00
" 26	65.00	" 9	55.00
		" 16	55.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	75.00
Apr.	115.00	73.12	100.00	Oct.	120.00	96.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

FOREIGN EXCHANGE

Premium on New York exchange is a virtual tariff on European imports. Each decline of 5% in sterling, for example, adds just that much to cost of our commodities. How badly Europe is in need of our products can be seen from the high premium the various countries are obliged to pay for American funds.

Recent weakness in exchange carried many to new low records. The following table shows the discount in New York of the principal exchanges, compared with low records previous to the present downward movement which started on offerings of grain and cotton bills:

Exchange	Par	'Low' previous to present movement	Discount, %	'Low' Nov. 8	Discount, %
Sterling	4.86	3.48	31.7	3.33½	31.5
France	0.193	0.0579	70.0	0.0574	70.3
Lire	0.193	0.0373	81.7	0.0338	82.5
Mark	0.238	0.0101	95.8	0.0109	95.3
Guilders	0.402	0.3125	22.0	0.2940	26.9
Swiss	0.193	0.1628	15.3	0.1507	21.9
Sweden	0.268	0.1630	29.2	0.1848	31.0
Norway	0.268	0.1380	48.1	0.1302	51.4
Denmark	0.268	0.1375	48.1	0.1303	51.4
Pesetas	0.193	0.1470	23.6	0.1270	34.2

England pays one-third premium. France pays more than three times normal, Italy more than five times normal, and Germany more than 20 times. Certain bankers maintain that an adverse exchange-rate is a blessing in disguise. They point out that it discourages imports and encourages increased home production and exports. One prominent international banker says that, in his opinion, England could fix her rate well above $4 if she would withdraw her support from the Continentals. He states, however, that there are certain advantages of a low rate at present and it is doubtful whether she really desires a higher exchange-rate.

RAILROAD OPERATION

The statement that six months of private railroad operation since March 1 cost the taxpayers approximately $650,000,000 while 26 months of government operation cost only $900,000,000 is characterized as unfair.

The Labor Board's wage-award increased by over $600,000,000 the annual payroll, and approximately one-third of this advance was covered in the period between May 1 and September 1. In the six months period ending September 1, $175,000,000 more was spent for maintenance of way and $230,000,000 more for maintenance of equipment than in the corresponding period of the preceding year. These increased expenditures for wages and upkeep practically offset the entire $650,000,000 government deficit for the first six months.

As a result of operating economies and efficiency efforts inaugurated since cessation of government control the roads have raised car mileage from 22.3 to 27.4 miles per day. Averaging loading per car was 29.8 tons on September 1, an increase in six months of 1.5 tons. Result of this increased movement and heavier loading has been to add the equivalent of 600,000 cars to freight service.

MONEY AND EXCHANGE

Foreign quotations on November 16 are as follows:

Sterling, dollars:	Cable	3.42½
	Demand	3.41⅝
Francs, cents:	Cable	5.30
	Demand	5.31
Lire, cents:	Demand	3.55
Marks, cents		1.48

Eastern Metal Market

New York, November 10.

All the markets are quiet and buying power is small. They are all fairly steady as to prices except tin, which has declined more than the others.

The copper market is steadier and quotations are firmer at the recent low levels.

Tin has declined and there is almost no buying.

The lead market is a little easier but fairly steady and buying is very light.

The zinc market is almost lifeless and prices have eased slightly.

Antimony is dull and a little lower.

IRON AND STEEL

Current steel-trade activities have to do mainly with cancellations of orders, further restriction of output of pig-iron and steel, and continued efforts by manufacturing consumers to reduce inventories and contract obligations before the end of the year. There are few new orders and more and more reminders of the aftermaths of some well-remembered booms.

It develops that here and there an independent producer would accept some business at the Steel Corporation prices, but in the main diminishing demand is met by cutting down output and by such an orderly retreat from the higher price-levels as will protect unfilled orders now on the books. As has been the case for some weeks, Steel Corporation mills are running nearer to capacity than the average independent plant, the percentage being about 80 for the former and 50 to 60 for the latter. The corporation's statement of unfilled orders on October 31 (not published at this writing) is expected to show a falling off of several hundred thousand tons.

Companies whose business is largely with motor-car makers have slackened further. The turning point in the latter industry is not in sight, little response being made to the first price-reductions.

COPPER

This market is steady but quiet. It is felt by some that the bottom has been reached. At least the continued decline has stopped at the 15c. level and rested there for over a week. On small lots for prompt delivery there has been a little shading of this price but it has been largely where cash needs were imperative. Buying by domestic consumers has improved but the betterment is slight. One bright spot is the continued sale to foreign buyers. This is not of large proportions, but it is steady at prices above domestic levels. We quote the market for both electrolytic and Lake copper at 15c., New York, for delivery the rest of this year and at 15.25c. for the first quarter.

TIN

This market has grown weaker and prices have again declined to levels obtaining about three weeks ago. Two factors are largely responsible: The speculative London market and the fall in exchange, though large supplies and poor buying power are also powerful influences. The London market in the last two days has had severe declines from the high points reached in the speculation following the favorable turn in the British coal strike and has nearly approached the level following the actual strike. Yesterday spot standard tin was quoted at £245 15s. and future standard at £251 15s. with spot Straits at £248, all recessions of [illegible] below the values on November 1. The New York market is also lower with 37c., New York, quoted for spot Straits yesterday. The market here is stagnant with consumers uninterested and with dealers neither buying for the long pull nor trading in the other way. There has been no activity on the New York Metal Exchange the past week. In the general market there were offerings last Friday of spot Straits at 37.50c., New York, and of tin for November-December shipment at 40c. with a little business. London is reported to have tried to buy but when its bids arrived sellers at those levels had withdrawn. They were really few at the best. Arrivals thus far this month have been 2150 tons with 3640 tons reported afloat. Imports to November 1 this year have been 44,923 tons against 25,896 tons to November 1, 1919. Of this year's imports 32,340 tons was from the Straits Settlements.

LEAD

There have been few developments in the last week. Quotations are nearly nominal, so little is the actual business transacted. The outside market has declined a little further to 6.75c., New York, or 6.50c., St. Louis, for early delivery at which levels, slightly above or below, some small business has been done. One dealer described the market as a catch-as-catch-can affair. Imports of 1000 tons of lead from France arrived on Monday but all sold in advance. The imported metal has practically vanished as a market price-factor. Late on Monday the leading interest reduced its quotation ¼c. per pound to 6.75c., St. Louis, or 7c., New York, for early delivery, another adjustment to meet the outside marke..

ZINC

Conditions are but slightly changed. Prime Western for early delivery is a little lower at 6.80c., St. Louis, or 7.25c., New York, but demand is of small proportions. The only buying consists of hand-to-mouth needs by galvanizers. Brass-makers are not active as to operations and their needs are less. Producers are not forcing sales and are still disinclined to sell for future delivery. Stocks are declining as well as production and the technical position of the market is regarded as sounder. Large operators are reported to have reduced the price of galvanized sheets one cent per pound which is something of a surprise.

ANTIMONY

There is almost no activity and prices have declined slightly. Wholesale lots for early delivery are held at 6.25c., New York, duty paid. Jobbing lots are ⅛c. to ¼c. per pound higher.

ALUMINUM

Virgin metal, 98 to 99% pure, is quoted by the leading producers at 32.90c. f.o.b. producer's plant in wholesale lots for early delivery, while from other sources it is quoted at 28 to 29c. per pound, New York.

ORES

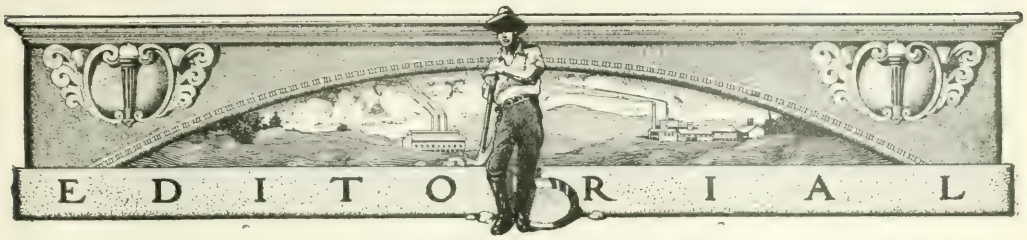
Tungsten: Quotations are nominal at $4.50 for Chinese ore and $5 per unit for Bolivian in regular concentrate and there is almost no business.

Ferro-tungsten is unchanged from the quotations reported last week.

Molybdenum: There is no demand and quotations are nominal at 75c. per lb. of MoS_2 in regular concentrate.

Manganese: There have been no developments and quotations are nominally unchanged at 45 to 50c. per unit, seaboard. Imports have been very heavy to October 1, this year, or at the rate of 47,001 tons per month which has been exceeded only once— in 1918 at 52,490 tons per month.

Manganese-Iron Alloys: There is no demand for ferro-manganese or spiegeleisen and quotations are unchanged. The former is quoted at $155, basis seaboard, for re-sale, and $170 for domestic and foreign alloy from producers, the latter at $75, furnace, with re-sale material available at substantial concessions.



T. A. RICKARD, - - - - Editor

ELSEWHERE in this issue we publish an article describing the custom plant for manufacturing zinc oxide, recently built by the Utah Zinc Company at Murray, Utah. The important item of freight frequently defines the grade of ore that can be stoped profitably when it must be shipped away from the mine for treatment. There are in Nevada and Utah a number of small mines that have been unable to profit from considerable deposits of medium-grade lead-free zinc ore because of the distance to the nearest market. The terms on which the Utah Zinc Company will purchase ore may be worth investigation by owners of prospective zinc properties in neighboring States.

PRODUCERS of copper and zinc are not alone in their difficulties. The International Nickel Company has curtailed its production of nickel matte from 4000 to 3000 tons per month, owing, it is said, to "general business depression throughout the United States". The slump in automobile manufacturing is doubtless an important factor. An antidote for this disagreeable announcement may be found in the decision of the company to construct a $3,000,000 plant for the rolling of monel metal at Huntington, West Virginia. Monel metal combines structural strength with the quality of resisting corrosion and is being used in an increasingly large number of industries. Some of our friends in Canada are disappointed that the plant could not have been built as an adjunct to the refinery at Port Colborne, but the availability of cheap fuel and consequent additional profit seem to have had greater weight with the directors of the Nickel company than an international boundary—which, on the whole, is desirable.

THE zinc-mining industry in the West is comatose. On November 1 the Interstate Callahan company in the Coeur d'Alene suspended production, officially assigning as the reason the labor troubles at the plants of the Grasselli Chemical Company, to which the Interstate Callahan ships its zinc concentrate. While the Grasselli company did request that shipments be suspended, we suspect that the operating deficit of $28,372 for the third quarter was the controlling factor in determining the action. At Butte the Anaconda company has shut-down three of its zinc mines, the Alice, West Gray Rock, and Poulin, and the Butte & Superior company stopped production entirely at the middle of the month. Butte & Superior recorded an operating loss of $147,000 during the second, and $102,000 during the third quarter of 1919. The average selling-price used in estimating income for the two periods was 7.64 and 7.53 cents respectively, but the price during October and November was considerably lower, so that the deficit for the last quarter threatened to be still greater. The heavy character of the ground in the Butte & Superior workings makes an unusual amount of current mine-repair necessary, so that the 'shut-down' expense will be approximately $75,000 per month. However, the ore-reserves are not being depleted when production is suspended. Operating costs, including charges for depreciation, but making no allowance for taxes and depletion, were $11.45 per ton for the third quarter, as against $11.52 for the quarter ended June 30. This last figure is the maximum in the history of the company, even exceeding the period of low labor-efficiency during the War. We hope that it will be but a short time before the present adverse margin between production-costs and selling-prices is converted into a favorable one, and our friends in Montana and Idaho are able to resume mining.

MR. HOOVER, on November 18, was chosen to be the first president of the newly created American Engineering Council. This is to be the governing body of the Federated American Engineering Societies organized, as declared in the constitution, for the purpose of "furthering the public welfare wherever technical knowledge and engineering experience are involved, and to consider and act upon matters of common concern to the engineering and allied technical professions". Engineers have long been handicapped by the absence of any organization by means of which their individual ideas might be co-ordinated; there has been no machinery for concerted action. The new federation is to be composed not of individual engineers but of a large number of engineering societies, both local and national. These member societies do not resign any of their present functions, nor is their individual identity submerged in any degree; they simply agree to co-operate with the hope that united effort will be effective where unorganized energy would be wasted. Some 70 organizations representing 100,000 engineers have already signified their intention of affiliating with the Federation. It is urged

that every society of engineers in the country become a member, in order that the weight of its influence may be behind Mr. Hoover and the other representatives on the Council. The beginning is auspicious.

MR. W. J. LORING has been elected president of the American Mining Congress in succession to Mr. Bulkeley Wells, as announced at the banquet of the Congress at Denver on November 18. The news of Mr. Loring's election to this honorable and important position will give keen pleasure to his friends in California and to the mining profession in many parts of the world. As Governor Boyle of Nevada said, the selection of Mr. Loring as president indicates a recognition by the directors of the Congress of the larger responsibilities and interests growing out of the present period of reconstruction in which the international phases of industry and commerce are insistently engaging the attention of thoughtful men. Mr. Loring has been engaged professionally in many lands and under divers flags, notably the flag that has flown closest beside our own in the Great War; therefore he brings to the activities of the Mining Congress an amplitude of economic vision, in regard to mining particularly, such as should prove of great value to its further capacity for public service. He follows a gentleman who endeared himself to the members of the Congress by his personal charm and public spirit; to Mr. Wells the Congress owes a debt that it is glad to acknowledge. He remains as a director and will support his successor in office. We wish Mr. Loring every success in his new departure.

A GOOD example has been set by the Esperanza, Ltd., an English company operating at El Oro, Mexico. We refer to the prompt publication of telegraphic news from the mine. This apparently decadent mining enterprise came suddenly into prominence by reason of the cutting of a rich vein on the fifth level; it opened out handsomely, the assays of the ore running into hundreds of dollars per ton in gold and silver; then almost as suddenly the orebody petered out in both drifts, north and south. The share-quotations, of course, reflected these vicissitudes of fortune and opportunities were offered for some tall gambling. Now, in former days, and with other companies, it was not uncommon for such news to be kept secret pending an opportunity for the directors and their friends to buy or sell stock in accordance with the good or bad news; indeed, one of the supposed compensations for serving as a director was this access to inside information, that is, instead of considering themselves as trustees for the shareholders such directors regarded themselves as privileged speculators. Some deals that were pitiful ethically but handsome financially were perpetrated in this way. Shareholders had reason to suspect the chicane, and protested feebly, but it was difficult to prove and the scandal would blow over. No better opportunity for ways that are dark has been offered than by the Esperanza affair and we note with pleasure that it was respectfully declined. In other words, the directors and the secretary did what was right, and in a manner that left nothing to be desired.

CO-OPERATION is the solution of our industrial development, according to Mr. Hoover. The projects of the future are too big and too complicated to be carried out successfully by individual effort. Problems of finance, politics, and engineering are involved. There are ahead of us enterprises so large that private capitalists cannot finance them without guarantees from the Government; so extensive that Federal as well as State governments must co-operate; and so complex technically as to tax the resourcefulness of engineers of every kind. An example is the plan to construct an immense system for electric-power distribution to include eleven of the North Atlantic States. With this end in view engineers of the United States Geological Survey are making a survey of the territory to allocate and appraise the waste incident to the present production and distribution and to devise means for its correction. It is proposed to construct a huge trunk transmission-line which will be fed from large steam-power plants situated at the coal mines, supplemented by the central stations now operating in New York, Philadelphia, Baltimore, Washington, Boston, Providence, and the other large cities, and sundry hydroelectric plants, which it is interesting to note will supply but 15% of the total. In the area of 60,000 square miles comprehended in the district there is required now approximately 17,000,000 horse-power, of which 7,000,000 is for railroads. By supplying a large part of this power from a main distributing system $300,000,000 per year is to be saved, according to the estimates so far made. Half of this economy will be in the saving of 30,000,000 tons of coal; half in the lesser cost of operation and maintenance of electrical machinery as against the large number of small steam-units that now supply the power. The average load-factor in the area being surveyed is 15%; it is believed that this can be increased to 50%, and that the consumption of coal can be reduced to half. The cost of the project has not been calculated, but if $300,000,000 is to be saved it is apparent that a capital investment of tremendous size would be warranted.

Concerning Shift-Bosses

The superintendent of a mine employing about 600 miners recently remarked that, if he could find twelve men whom he knew to be as good shift-bosses as the twelve he already had, he would put them to work at once with confidence that he could thereby reduce the cost of mining at least 10%. He added that any member of the staff, including himself, could be replaced more readily than some of the shift-bosses. Doubtless he exaggerated, for the sake of emphasis; nevertheless the remark expresses a fact that is not always appreciated. The shift-boss serves as a buffer between those who direct the work and those whose manual labor must accomplish it. A good boss must be loyal to the company, but at the same time he must not lose sight of the fact that the men under him expect him to look out for their welfare.

He must be a diplomat if he is to avoid trouble. The category of the successful shift-boss's qualifications includes many characteristics. In the first place, he must know exactly how the work should be done. While an exceptionally good miner frequently fails as a shift-boss, a man who has no more than average ability as a miner rarely fills the part. He cannot retain the respect of his men unless they believe that his knowledge and judgment of the best way to do a thing are, as a rule, better than their own. This, obviously, applies to any kind of supervision, but in underground operations it is especially important, first, because there are no rule-of-thumb methods that will fit all conditions, and second, because in a large mine it is impossible to consult with the foreman or superintendent whenever unusual situations arise. It is here that the young college graduate is likely to find the greatest difficulty. Unless he has had sufficient experience in 'handling' ground as a miner or timber-man he is at a serious disadvantage, for the men soon discover his shortcomings. The shift-boss must set a personal example to his men; unless he is diligent, energetic, and careful, unless he co-operates with others, the men under him are likely to be similarly deficient. Nothing is more detrimental than a lack of co-operation between the miners as well as between the shift-bosses themselves, whose activities are, in varying degree, dependent on each other. The tendency too frequently is to consider one's individual record, without regard to the welfare of the mine as a whole. The most important qualification is doubtless that intuitive quality, the ability to handle men; this requires sound judgment, tact, a habit of square-dealing, the ability to discipline strictly yet fairly, a large stock of common-sense, and the personality of a leader among men. A boss's judgment must enable him to measure his men and deal with them according to their individual peculiarities. The day of the boss who rules by virtue of his prowess with a pick-handle has passed; the time when the Western miner wants to be addressed as 'Mister' has not yet arrived. Methods that may secure good results from one man may simply antagonize another. It is for the shift-boss to fit the treatment to the individual; to do this he must have tact. Tact also is essential for maintaining discipline; likewise fairness. Few men will complain of strict rules if they are uniformly enforced. Miners, like the rest of us, are indignant if they see another man favored with special privileges; it is also true that they resent any action on the part of the shift-boss that imposes unnecessary hardship on a fellow miner. A strict but impartial boss who has no favorites and pays-off no grudges, but is absolutely 'on the square', succeeds where the lenient one, who lets his personal feelings influence his treatment of the men, fails utterly. The measure of a shift-boss's success is, of course, the amount of profitable work that the men under him accomplish in a year, rather than in a day, or in a month. Personality is an important factor. Some men can give a peremptory order, a casual direction, a suggestion, or a request—and the man who is told to do the work does it as a matter of course. Others, who try to boss, antagonize a man by their very attitude; the miner resents their instructions no matter how they are given. Many of these qualifications are needed in any man in a position of authority, but to a varying degree; they are perhaps more necessary in a shift-boss underground because of the conditions amid which the work is done, that is to say, in the dark and in places where constant supervision is impracticable. Moreover, the average miner is 'temperamental'; he is continually complaining, sometimes in earnest, more often from habit; and he is always on the point of "calling it deep enough". It is little wonder that shift-bosses who really measure up to their job are hard to find, and that the superintendent whom we quoted at the start uses fewer bosses than he would like to have because he cannot find men properly qualified. Apparently young college-men are not in demand as shift-bosses. As one manager says, "unless a graduate is prepared to put in several years of hard work as a miner he had better get his underground education while serving as a surveyor, sampler, or engineer. If he is observant and intelligent he can learn enough about the manual operations of mining to become a superintendent or executive, but the chances are not in favor of his becoming a good shift-boss." This may seem strange; but it is the deliberate opinion of more than one successful executive. What then is the best material for a shift-boss? Apparently the best are the men who have had enough elementary schooling to be able to read intelligently, write readily, and figure fairly well, and who started to mine as soon as they were big enough to do a day's work. If the college-boy is to become the shift-boss of the future he must go through a similar, though shorter, course of practical instruction. Meanwhile we feel warranted in saying, with confidence, that a great deal of bad work is done in mines and much ore is overlooked on account of the attempt to run a mine with too few shift-bosses.

The Brass Check

A friend has sent us a copy of Mr. Upton Sinclair's book, the title of which will be cryptic to most people, for it signifies the symbol of prostitution. The sub-title is 'A Study of American Journalism'. It is a book of 450 pages and is crowded with first-hand information. We found it intensely interesting and recommend our readers to get a copy of it from the author, whose address is Pasadena, California. The price of a single paper-covered copy is 60 cents post-paid. Like most of Mr. Sinclair's writings—like his 'The Jungle', for example—this book cannot be included in what is called 'polite' literature; there is no mincing of words or softening of rough places with euphemisms; he hits out roughly and viciously. The book is marked by bad taste in its first part, in which he tells about his personal affairs, his conjugal troubles, and other matters that most people would consider intimate; he is crudely egotistic and egoistic; but the general effect is to give authenticity to this revelation of newspaper corruption and to heighten the disgust, if not dismay, evoked by the recital. In the latter half of the book he

discusses his subject less violently and apart from his own vendetta, so that he becomes more convincing. As our criticism will have indicated, the book is not pleasant reading, any more than his exposure of the Chicago stockyards, but it is written with marked literary skill and it is one that every serious man ought to read, because it bares a condition of affairs that undoubtedly undermines the very roots of democratic institutions in the United States.

Mr. Sinclair presents a mass of evidence to prove that our newspapers and magazines are unreliable, subservient, and corrupt. When he touches upon matters about which we happen to know, we find him correct, so that we infer that in the main his testimony is trustworthy. We make this reservation however: that he singles out the "capitalistic" press for special attack, whereas we have no reason to believe that the radical press as a whole is any better as regards perversion of news and the subordination of editorial opinion, and the frankly anarchist press, with which Mr. Sinclair has evident sympathy, is open to the charge of vicious disloyalty to our institutions. Early in his career he fell foul of the editors of the metropolitan press, because he attacked the 'trusts'; and he found himself balked by the brick wall of fortified capitalism. That made him bitter. Then he discovered that the papers cared less for honest information than for sensational claptrap. When he attacked the Beef Trust in 'The Jungle' and in newspaper articles, his so-called muck-raking placed him under the ban; everything he did was misrepresented in the newspapers; his socialistic ventures were smothered with organized ridicule. He became angry. He went on the warpath. Hence this book. It is an *ex parte* statement, of course, but he speaks from the inside, and with detailed knowledge of his subject. He quotes the personal experiences of sundry friends, as well as his own. All this is done not in vague terms, but with names and dates; it is specific. He shows how fictitious telegrams are concocted and published; how lies are printed, and how they remain uncorrected when protest is made; how editors play the lackey to rich patrons; how headlines are made to misrepresent the news below them; how the yellow papers lie and cheat; how wholesale falsehoods are foisted on the public either for cheap sensationalism or for a private interest. For example, a newspaper publishes its own views and labels it a "special dispatch" from Washington. Another publishes telegrams, day after day, signed by imaginary correspondents in London, Paris, or Berlin, all of them simply a rehash of items appearing in the London papers. The whole system of news-giving and current comment is in the hands of predatory exploiters, who either own the papers themselves or own the editors or get what they want by means of subsidies and bribery. By aid of the [illegible] exercises an industrial and political power that stultifies our [illegible] politically by an organized campaign of silence concerning him in the newspapers, and how that was clinched by publishing one big lie. We hold no brief for him nor for Mr. Sinclair; we quote them as part of the record in the case against the press. Next come the news agencies, which poison the news at its source. Nine hundred daily papers receive and print the news dispatches of the Associated Press. Think what a power that represents; it means that a sensational telegram from a reporter is printed about fifteen million times and read by thirty million people. The reporter may be honest and intelligent; he may be controlled or bought by somebody. The Associated Press may use the reporter of a local paper as its correspondent, and he may be in the employ of one side in a big controversy; it may publish a lie sent by an agent in the interest of an individual or a corporation. Such lies or mis-statements appear in thousands of newspapers; and correction is futile, even if attempted. Great wrongs are perpetrated and bitter feelings are generated by the controlled press, which confines its argument not to the editorial columns but uses the news columns for propaganda and either fails to print the news, or tampers with it, or invents lies. All of these things are done, and one of the results is to cause social unrest, to provoke hatred against organized wealth, to incite a destructive type of radicalism. Obviously the big news agencies should be treated as public utilities and be subjected to discipline instead of being run as a piece of private property. The tampering with a news dispatch, the publication of a concocted telegram, or the placing of a lying headline should be rendered punishable as fraud. Every paper should be licensed, and the license should be withdrawn when proof is furnished that the newspaper is guilty of gross misdemeanors; in short, the public and the nation should not be at the mercy of a predatory press or be debauched daily by yellow journalism. We in San Francisco know what that means: two in the morning and two in the evening. Mr. Sinclair pays his compliments to our local press, but he expresses admiration for Mr. Fremont Older, formerly of the 'Bulletin', whose recent cynical avowal of his own performances suggests the low state of press morality in this city. Mr. Sinclair has a good deal to say about the press of Denver, with which also we are well acquainted; it can be said of Denver and of San Francisco that if a community gets the kind of press it deserves then it is about time for the people of Denver and San Francisco to become severely introspective and ask themselves what they have done to deserve it. Here we may add that we take no stock in the suggestion that American papers are exceptionally bad; the same kind of prostitution degrades the press of Europe, and no city has such a numerous and varied gutter press as London. However, that is no consolation. They have Northcliffe and we have Hearst; let the contrast suffice. Both are a menace to democratic ideals. Indeed, the healthful development of our institutions is incompatible with controlled news agencies and a prostituted press. We recommend our readers to get a copy of Mr. Sinclair's book, examine the evidence, and arrive at their own opinion on the subject.

The Business Outlook

By Charles T. Hutchinson

Deflation, nearly two years overdue, is under way. The artificial abnormal boom that affected every branch of industry on account of the War is subsiding fast, and now "normalcy" is upon us. Industry is experiencing the pangs incident to a gorged stomach full of rich food, and the purging process is painful but necessary, while the chances for a better and bigger constructive development of Nature's resources are brighter than ever.

War's demands threw all of the considerations under which business is ordinarily conducted into the discard. Price or cost was relegated into a secondary place. Delivery became the prime consideration. Time was the essence, and as everything had to be produced at abnormal speed in spite of the reduced productive capacity consequent to the withdrawal of millions of labor-units for military service, an artificial shortage of labor ensued that brought the cost up to an unheard of figure.

The result was the 'silk shirt' period. The three-dollar-a-day man, finding himself in the possession of ten dollars, fifteen dollars, and even twenty dollars for one day's time, rather than one day's labor, went on a joy-ride. So did his boss. They bought lavishly of totally unaccustomed things. The vendor of fancy clothing, the purveyor of pleasure cars, the real-estate man, and the rest of the crowd experienced a boom the like of which they will probably never experience again. Our Uncle Sam himself took part in the fray, and devised a fearful and wonderful system of taxation designed to skim most of the cream off the War profits, in order that the inevitable headache of the morning after might be assuaged by some money in the treasury with which to pay the bill.

Now that the fog of battle is clearing, stock-taking is under way. Prices, securities, and all sorts of commodities are passing slowly and tortuously through the clothes-wringer of readjustment, and the water is slowly trickling out. It hurts. There is no doubt about that, but, as the conscientious mother said to her fractious child when administering corporal punishment with vigor and the aid of a slipper, "Johnny, this is altogether for your own good."

It is not surprising that the labor unions are restive at the realization that the old easy-going slackness in factory discipline is about over. Bad habits are easy to acquire, but difficult to overcome. The artificial limitation of output, which has been encouraged by many labor leaders, and was tolerated during the War period by employers because they could not help themselves, must go. The temporary hiatus in general business is the factory managers opportunity, and he is taking a deep breath and sailing into his house-cleaning with a gust of enthusiasm that is good to see.

In the factories of the country, the era of hiring and firing has returned. Unfilled orders in every field are diminishing, and, as a result, men are being weighed in the balance of performance. The loafer, the slacker, the unskilled, are being weeded out with vigor, and the effect upon the real mechanic and trained man is salutary. Many thousands of unskilled workers from the so-called non-essential industries, who, attracted by the high wages and slack discipline maintained in the shipyards and other branches of the metal trades, found their way to a place on the payrolls as mechanics, are out of a job. As a consequence, the ranks of the waiters in hotels and restaurants are again becoming preponderatingly male. Elevator-boys and bell-hops are again masculine, while real machinists are once more operating the tools in the workshops.

Throughout the country, the chief topic of conversation is the condition of the automobile industry, and its allied trades. Here is where the blow has hit hardest, with the possible exception of textiles, and here, may it be remarked, was where inflation was greatest. Attracted by the lure of enormous profits, automobiles and tires have been badly overdone. Sassy Sixes and Snappy Eights, even Nobby Fours sprang into existence overnight. Anybody who could dig up a few thousands and lease a little factory space, could assemble some sort of car, and, aided by bright attractive paint, launch it upon the market and, apparently, get by. It was the same with tires. Akron, the home of the rubber factories, became a great hive of industry. Hardly a week went by that did not herald one or two new brands of cars and tires.

Even the great established concerns responded to the psychological effect of the boom. It was in the air. They took their profits, or what was left of them after the tax-gatherers got through, borrowed more money, built more factory capacity without stint, and so on, *ad lib,* until the bubble was pricked. Now they are facing a ruthless pruning process with the prospect of operating for some time at fifty, or even forty, per cent capacity, to which must be added the necessity of marketing a large overstock of high-cost perishable goods under conditions of a forced sale.

The automobile 'game' was one of the big factors in the wrecking of the labor market for other branches of industry. The Lake Superior copper district was almost depopulated by the insistent demand on the part of the Detroit factories for any old kind of men at fancy prices. The 1920 census, taken during a period that might be called the apex of the boom, shows clearly the migration from the rural districts to the congested manufacturing districts. Now the factories are disgorging the un-

digested mass of 'outside' labor, which is going back to the farm or the mine, as the case may be.

The automobile industry has been a vast consumer of steel in many of its manufactured forms, and, consequently, of all other metals. The deflation process from that angle is going to add to the already large stock of metals, so no great appreciation in the demand for the produce of our mines may be expected until building operations are well under way.

Building construction, during the War, stopped altogether. It was regarded as a non-essential industry, and priority orders placed materials of all kinds for building purposes way down the line, so that it was practically abandoned altogether. The enormous rents now being paid for office and factory space as well as for dwellings in all of our cities and towns are a consequence of the growth in population with no increase in housing facilities for nearly four years.

Building is beginning, timidly in some places, but nevertheless it is well started, and will gather impetus from day to day until it may even generate into a race to see who will be ready first. The wave is well under way in New York city, more so there than anywhere else in the United States, and is working its way westward slowly but surely. Here, then, is the substitute for the outlet of metal products formerly consumed in such large volume by the automobile industry.

Even building construction, as well as nearly everything else, is being retarded as much as possible, by the hope of investors and buyers for lower prices. The National Association of Purchasing Agents, at their annual convention only a few weeks ago, passed a resolution to notify all of their members that in their judgment, all requisitions should be withheld from action until the last minute, in order to take advantage of the general downward tendency of all markets. Copper is in the doldrums, the greatest producers of quicksilver in California have shut-down, the troubles of the gold miner have been discussed fully in these columns, other metals are in sympathetic accord with these same conditions, while the fact that we are still technically at war with a considerable portion of Europe, together with the chaotic conditions still obtaining there, have kept the door to one of the greatest markets for our metals resolutely closed.

In fact, the miner has reached low water small, but the tide is due to turn, and soon. First there is the labor situation, which is improving slowly but surely, for reasons that have already been cited. Then, there is the market, which also is improving by reason of the resumption of building operations, and last, but not least, there is the most encouraging symptom of all, that is the result of the presidential election.

The sweeping victory of the Republican party shows one thing above all artificial issues, and that is a complete repudiation of the Wilson regime and the Wilsonian policies, domestic and foreign. The Republican majority in both houses of Congress is overwhelming, and, at last, after years of chaos, we will have the legislative and executive branches of Government in accord. Progress is assured. Constructive legislation will follow as a matter of course. We may at least hope for a reasonable economy in the administration of Government affairs, and the disbandment of the numerous War Bureaus with their hordes of clerks and petty officials. The Wilson-McAdoo tendency toward Government ownership and Government interference with business also goes into the scrap-heap, we hope forever.

The iniquitous excess-profits tax, with its destructive effect upon initiative and enterprise, will certainly go, and in its stead will be substituted some form of general sales-tax that will enable the Government to meet its obligations without destroying the source from which taxes flow. And then, Mr. Burleson will no longer be Postmaster-General. But enough of this panegyric.

"Normalcy" is in sight. The world is at last getting down to business. Goods must be manufactured and then sold. The old machinery for selling is being brought out of cold storage, brushed up, cleaned, and manicured ready for the fray. Expense accounts are again subject to scrutiny, and the dollar is not being thrown to the birds as a thing of no consequence. Caution, study, and careful examination is once more being devoted to betterments. The leaders of industry have not been idle during the last year, and much quiet unostentatious preparation has been under way toward the perfecting of sales organizations, methods of distribution, and the other machinery for selling, in order that the commercial machine might be ready and able to function when the time came. Underlying the surface, down-in-the-dumps condition of the stock and security market is the real, solid, sub-stratum of common sense that discerns in present conditions a necessary and beneficial purging of the whole business structure, whereby the artificial unhealthy extravagance of war profiteering has been brought to a head, lanced, and finally cured.

During a trip through Eastern and Middle-Western centres, I did not succeed in isolating one single pessimist. Even those hardest hit, the automobile crowd, for instance, regarded the drastic remedy now being applied as a good thing in the long run, and the real leaders of that industry are satisfied with the survival-of-the-fittest test that is now being applied with ruthless vigor. Money is tight, not scarce, and hard to get even at 8% for preferred short-time commercial loans. The cold blue eye and icy stare of the banker is the portion of those who ask for help for any doubtful enterprise. The custodians of the people's money are sitting tight, waiting to see the inexorable sorting process weed out the lame, the halt, and the blind, and even the best of the industrial leaders are paying fancy prices for money.

What a chance for the investor! The late J. Pierpont Morgan once said that any man who was a bear on the United States would go broke. Investment bankers are issuing charts showing the market tendency of municipal, railroad, and industrial securities and their relative return for the last five or six years. Seven and even eight per cent for first-class securities is the rule at

present prices. With most of us, the situation is one to make us lick our chops hungrily, and think of the story of the man, who, when riding by a great factory remarked, "I could have bought that site for $5000 ten years ago, and now it is worth a million". His hearer asked, "Did you have the five thousand at the time?" The man did not reply.

In the meantime, watch Mexico. Since Don Porfirio, aged and worn, had the reigns of government wrested from his shaking hands, prospects for development of the resources of our oft-times troublesome neighbor on the South have never been brighter. In fact, the makings of a boom are not lacking. President-elect Obregon is known to be a strong man, a constructive thinker, and is anything but the Gringo-phobe that either Carranza or Villa were. Already many of the mines, idle for years, are making preparations for re-commencing operations, while much quiet unostentatious exploration work is under way looking toward the development of new properties. A number of enterprising manufacturers of mining machinery already have their scouts on the ground examining the field and making reports to their principals.

Unless the outgoing administration shall take action before, recognition of the Obregon regime and the restoration of diplomatic and consular relations will be one of the first acts of the Harding administration. A return of business confidence will quickly follow, and then the rush will be on. Europe will follow suit, unless it accords recognition to Obregon before we do, and there will be a merry scrap for Mexico's trade. Fortunately, the United States leads the world in the manufacture of mining machinery and appliances, and it will be years, if ever, before Europe will be able to compete from the standpoint of either efficiency, delivery, or design. Let us hope that our own people will cinch their advantage and maintain it for all time to come. Before the War, Germany was our chief competitor in that field; she flooded the market with cheap machinery that was attractive in price only, and spoiled many a legitimate sale through her price-cutting policy. Many of our advertisers can remember vividly the time when hammered-steel battery-shoes and dies were sold for as little as 2½c. per pound delivered at west-coast Mexican ports by the Krupp works, and other staple articles such as stamp-mills, centrifugal pumps, and steel tanks for cyanide-plants in the same proportion. There should be no return to this condition, and probably there never will be if our own people get themselves properly organized to obtain and hold the business.

Nineteen-twenty-one will be a most interesting year. The whole industrial fabric of the Nation will throw off its wartime shackles and go to work, with the intelligent help, let us hope, of the Washington government. The conservation policy that lets our natural resources go to waste will be packed away in moth-balls together with its proponents, and we will see electrical development under way on an unprecedented scale. Hydro-electric power in the United States is still in its infancy, and its future development will go a long way toward solving the coal and fuel-oil problem. With the removal of the excess-profits tax, and of the consequent stifling of individual enterprise, and at least the substantial modification of the postal-zone system for second-class mail matter, all of those who are helping to build and construct will take fresh heart and tackle the work with renewed vigor.

Rhodesia Broken Hill

Operations of the Rhodesia Broken Hill Development Co. are discussed in a recent issue of the 'South African Mining and Engineering Journal'. Edmund Davis is quoted as saying:

"We have, as you know, various deposits, some rich in zinc and others containing lead and zinc ores of about similar percentage, but our principal work has been devoted to the production of lead, which is the easiest and earliest profit-earning part of our enterprise. We have not only the two smelters taken over from the Rhodesian Lead & Zinc Syndicate, but we are also erecting two more, one of which we think it may be necessary to keep in reserve, in the event of anything unforeseen happening in the operating of the plant. Our present work consists in the first instance of the development and production of lead ores at No. 1 kopje, and secondly, the general prospecting of our mineral area, and in particular the proving of reserves of zinciferous ores. The result of the work so far carried out on No. 1 kopje has been the proving of a main orebody of very high-grade lead ore, increasing in area and maintaining its richness to 150 ft. below the surface. Below this depth the deposit appears to be split by a ridge of dolomite and at least two orebodies exist below the central part of the workings to a considerable depth. It is satisfactory to note that boring has not yet shown any limitation in depth in the orebodies, the prospects of further continuance beyond the depths so far reached being good. In addition, the boreholes have shown that a large body of zinc ore exists in the vicinity of this kopje, a marked tendency being shown for the replacement of lead by zinc, which should simplify treatment. As far as depth is concerned, ore has already been struck at two points at a depth of 300 ft., these points being 250 ft. apart. In the course of development it became necessary to keep not only the present plant, but the additional furnaces supplied, to make provision for draining the mine at a faster rate than previously, and sufficient additional pumping-plant is being supplied. Summarizing the estimate of ore from the main bodies so far proved, shows about 210,000 tons, averaging 24% zinc, 2½% lead, and ½% vanadic acid, and about 305,000 tons averaging 27% zinc, 10% lead, and between ½ and 1% vanadic acid, these estimates being in no case based on anything below a depth of 100 ft. It is well known now that the main ore deposits are not of a superficial nature, and we are advised that, owing to probable bulges in orebodies, the known existence of ore below the depth used for basing the estimates referred to, and the probable existence of large quantities below this depth, this estimate does not approach the total available ore."

National Department of Public Works

*Two outstanding facts which were not anticipated when the public-works movement took shape in April 1919 are (1) that the engineers of the country in good faith started something which they do not now seem inclined to finish, and (2) that the scope of the movement and its ramifications extend beyond all limits written or spoken of at the time.

I am unable to suggest any adequate reason why the original enthusiasm of so many engineers has apparently been reduced to a passing interest. Engineers responded warmly to it in the first instance and it therefore may safely be assumed that they had original and genuine regard for it. No doubt the enthusiasm of many engineers has been cooled, and in some cases their active opposition has been brought about by the very skilful campaign carried on by members of the Corps of Engineers, U. S. Army. We do not complain of such activities of the Army engineers. Their opposition to a public-works department was expected, and we must not be surprised if in the conduct of that opposition they do not neglect to do the very obvious things which we would do if the situation were reversed. Suffice it to say that many of the civilian engineers on whom we counted for support have been won over to the cause of the Army engineers, and as magnanimous opponents we must congratulate the Corps on its achievements.

To summarize as to the prospects for a department of public works: It is my belief that the principle is thoroughly settled in the minds of the public and of a majority of the members of Congress. The important question remaining is the kind of department that we shall have. This involves a discussion of the matter of engineering control of Government operations. Shall it be civil or military?

It is easy enough for the thousands of engineers of the United States to assert that engineering work of the Government shall be under civilian control, but it is quite another thing to establish that control. It is not difficult for the civilian engineers of the country to set up the claim that our military engineers are not well-rounded engineers; that they are inbred; that the greater part of their meritorious performance is done by their civilian assistants who secure no credit therefor; that the Corps of Engineers is an autocracy and therefore unsuited to the control of public operations in a democracy. Even if we assume for the moment that this is true the fact would not dislodge the military engineers from their present commanding position in the civil work of the Government. By constant application and attention to detail these military engineers have, during past years, created in Congress the habit of providing that the U. S. Engineer Corps shall do thus and so, and whenever a civilian engineering organization is designated the first process is to overcome the aforesaid habit.

*Abstract of a report by M. O. Leighton.

The engineers of the country must decide speedily whether it be their desire to have military engineers in control of the public-works of the Nation. If the civilian engineers do not bestir themselves and take a sustained and active interest in this matter they will suddenly find that the die has been cast. When government reorganization takes place the provisions made for engineering control will crystallize and will not become mobile again for at least a generation. It all comes down to a question of what the civilian engineers want and what they will work for. They are strong enough numerically and powerful enough in influence to guide the decision if they choose to do so, but they must not entertain the notion that their adversary is asleep.

What is an Army engineer, and what do civilian engineers wish to do with him? He is first of all a gentleman; has high mental qualifications, is schooled in discipline, is well-poised, and is deliberate in his judgments. He is an excellent friend, an astonishingly attractive companion, and a man whose acquaintance is always productive of benefit. He carries himself well and begets confidence especially in legislative halls.

If the testimony of some of the line-officers, some of the engineer-officers, and many of the reserve-officers, be correct, the Corps of Engineers exhibited in the late war the not wholly commendable results of their high state of specialization. This ought not to be so. Our corps of military engineers should be given responsibility and experience in every line of engineering laid open by government activity. They should take their place in the engineering work of the arid lands and the swamps, the highways and the forests, the mines and the laboratory. They should be given the financial and the commercial training necessary to the proper conduct of operations, so that in war exigency they shall be entirely competent to perform all the engineering functions that present themselves. These facts, which it is believed no thoughtful person will deny, bring us to the forks in the road. Shall, by reason of this necessity for broad engineering training, the corps of military engineers be in command of all the Government's public-works function, to the perpetual subordination of the civilian engineers? Or shall they constitute, as was originally intended, a military arm of the Government and be given their training and experience by temporary assignment to positions in civil work; by transfer therein according to plans most advantageous for the acquirement of such diversified experience?

The civilian engineers of the country must decide, and if they are defeated in the forthcoming contest the fact will, in my opinion, be an evidence that the military engineers deserve their success, for it will show that whatever may be their engineering qualifications and however severely their ideals may depart from those which are supposed to constitute the corner-stone of democracy, these men do, nevertheless, possess an essential characteristic which the great body of civilian engineers does not, namely, that they know men and are ever vigilant in the exercise of that knowledge.

The Zinc-Oxide Plant of the Utah Zinc Company

By Arthur B. Parsons

Introduction. Heretofore the nearest market for oxidized zinc ore mined in Utah, Nevada, and the adjacent States, has been at Canon City, Colorado, where the plants of the Ohio Zinc Co. and the Empire Zinc Co. are situated. Both these companies make zinc oxide by volatilizing the metal directly from the ore by means of the Wetherill process. Increased freight-rates in 1918, with the prospect of still further increases, promised to make the marketing of ores of this character still more costly, and it was with the aim of reducing the railroad haul of zinc ore from far Western mines that the Utah Zinc Company undertook the construction of a plant at Murray, six miles south of Salt Lake City. James W. Wade and associates, who organized the company, were interested in a lease on the property of the Tecoma Consolidated Mining Co. situated 24 miles south-easterly from Tuttle, Nevada, a station on the Tecoma branch of the Southern Pacific railroad, where 30,000 tons of oxidized ore containing 20% zinc and 60,000 tons averaging 16% have already been blocked out. This ore has an unusually low lead content and accordingly is suitable for the making of a lead-free zinc oxide of the kind required in the rubber industry.

The ore deposit originates from the replacement of a stratum of limestone underlain by granite. At the contact the feldspars in the granite have been completely kaolinized, thereby forming an impervious layer along the foot-wall of the zinc deposit. The zinc was originally associated with a body of lead-silver ore that lies immediately above; it was dissolved, however, and re-precipitated in the brecciated limestone, where the impervious kaolin served to concentrate it into a deposit of high-grade ore. There is no well-defined hanging wall; the tenor of the ore gradually increases until at a distance of 100 ft. there is little zinc present.

The overlying lead-silver ore has been mined and the stopes are caved. This will make the mining of the zinc ore more difficult, but a slicing system is being used that will supply clean ore at a reasonable cost.

The ore from Tecoma is to be the nucleus for the operation of the new plant, which has just been started. The company, however, will purchase suitable ore on a custom basis to serve as a supplementary source of supply. Shipments are being received regularly from various lessees in the neighborhood of Ely, Nevada, and from several districts in Utah. While sulphide ore can be treated by the Wetherill process after a preliminary roast, the Murray plant has no roasters and is not prepared to receive raw sulphide, although by-products from other plants where the roasting has been done are acceptable. The zinc in the ore may be in the form of carbonate, silicate, or oxide, but it should not contain more than approximately 1% of lead.

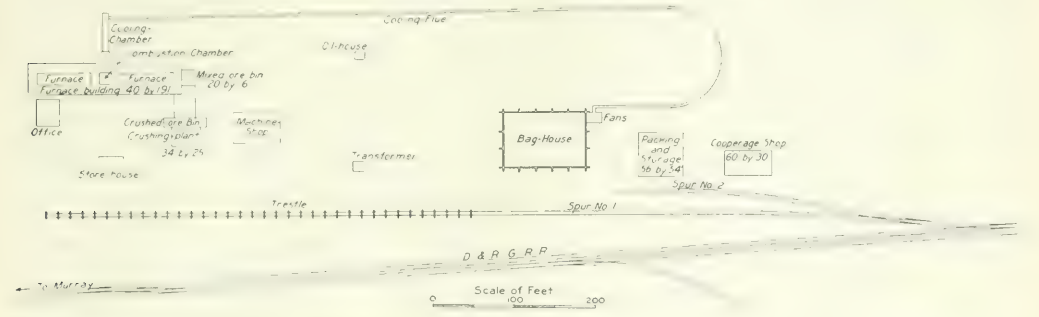


Fig. 1. Plan showing arrangement of the buildings

Uses of Zinc Oxide. Zinc oxide is used for two principal purposes, namely, for the manufacture of paint, and as an important constituent in finished rubber goods. In recent years, owing to the rapid expansion of the automobile trade and the increased demand for tires, the rubber industry has outdistanced the paint industry in its demand for zinc oxide. The process for making oxide for either purpose is practically the same. The lead content of the ore is the principal factor in determining the use to which the resulting oxide shall be put. Lead, if present, volatilizes at a lower temperature than does zinc, so that whatever lead is in the ore will be found in the product. In the manufacture of pigments an admixture of lead is not only permissible but desirable; the only requirement is that the lead be entirely converted to the basic sulphate, which is nearly white, and accordingly does not have the effect of discoloring the pigment as would any of the oxides of lead. To effect this reaction it is necessary to provide a combustion-chamber for the

THE ZINC-OXIDE PLANT

hot fume before it enters the cooling-flues. As may be seen from the accompanying drawing, Fig. 3, the furnaces at Murray are provided with such a chamber, so that leady oxide may be made without material alterations in the plant, if at any time it becomes desirable to do so. However, the present intention is to confine the operation of the plant to the manufacture of lead-free zinc oxide for supplying the rubber industry. When added to the mixture of pure rubber and sulphur in the vulcanizing process, zinc oxide acts as a pigment and gives the product its white color. However, the essential function of the oxide is not the whitening effect, but the fact that it has the unique property of increasing the tensile strength of the finished material. George C. Stone gives the following figures, which show the effect on the tensile strength, and the simultaneous diminution in the elongation, produced by introducing varying amounts of oxide.

Zinc oxide added, %	Tensile strength lb. per sq. in.	Elongation, %
25	2400	720
35	2400	700
45	2700	680
55	2500	620
65	2000	540
75	1300	400

In the vulcanizing process lead reacts with sulphur to form lead sulphide; the latter is brittle and translates this property to the rubber. The admixture of more than 0.25% of lead is prohibitive.

THE ZINC PLANT. The Utah Zinc Company selected Salt Lake valley as the site for its plant because of its convenience for transportation. Railroads from all parts of Nevada and Utah converge there. The Denver & Rio Grande right-of-way cuts through the property and a short spur-track grades onto a trestle 400 ft. long, which passes immediately over the ore-bins and stock-piles, while a branch spur serves the packing and storage house for the convenient shipment of the finished product. The accompanying illustration, Fig. 1, shows the general arrangement of the tracks, flues, and buildings.

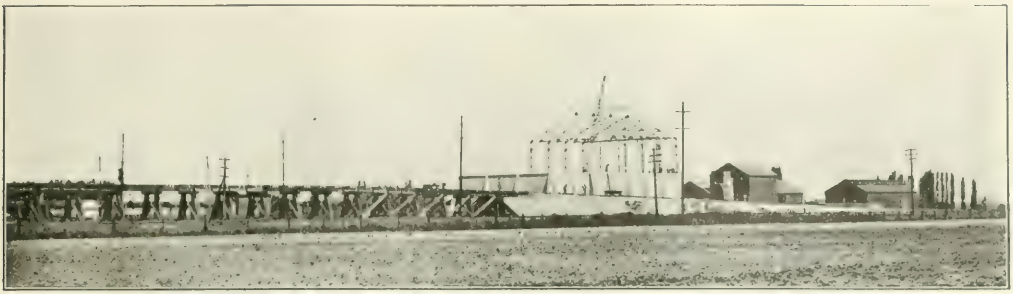
The crushing department is equipped to crush 150 tons of ore during an eight-hour shift. A 20-in. belt-conveyor carries the ore from under the railroad-trestle to a 10 by 20-in. Allis-Chalmers Blake crusher preceded by a grizzley spaced ¾ in. A 16-in. bucket-elevator lifts the crushed product to a ¼-in. square-mesh trommel, the oversize from which gravitates to a set of 14 by 30-in. rolls, of Denver Engineering Works manufacture, and thence to the foot of the same elevator. The product that passes the trommel goes to a 365-ton crushed-ore storage-bin into which it is distributed by an 18-in. belt-conveyor feeding a 50-ft. shuttle-conveyor at right-angles to it. The course of the ore is shown on the accompanying flow-sheet, Fig. 2.

Hand-trammed ore-cars are filled from the bin and weighed on a Fairbanks platform-scale ready for mixing with coke-breeze that is likewise trammed from storage. A charge composed of the proper proportions of ore and coke, with sufficient water to moisten to a dampness equivalent to that of foundryman's sand, is fed to a 40-ft. Oshkosh concrete-mixer, where it is given five minutes of thorough mixing.

In the Pennsylvanian plants anthracite coal is used for fuel. The characteristics required are high-carbon and low-volatile content, and the fuel should produce the minimum amount of smoke. Bituminous coal is unsatisfactory, but coke, especially if low in sulphur, serves well. Coke-breeze of suitable fineness for use without crushing is obtained at a reasonable cost by the Utah Zinc Company and will be used exclusively.

The mixed product is elevated by means of a second 60-ft. bucket-elevator to the 150-ton mixed-ore bin. A portion of this bin is reserved for coke to be used in forming the bed on the grates of the furnaces. The plan is to do all crushing and mixing during the day-shift, so that night-work will be confined to operating the furnaces and shaking bags in the bag-house. The charge-cars are low and wide with a hinged lip that can be turned down to form a shelf flush with the bottom. The object is to facilitate shoveling from the car. The furnace-building is constructed of concrete and structural steel, with roof and sides of corrugated iron, while the operating-floor is of reinforced concrete.

DESCRIPTION OF THE FURNACE. The general scheme of the furnace is shown in Fig. 3. A good view of the interior of the furnace, taken from the combustion-chamber, shown in Fig. 5. The gates had not been put in place when this photograph was taken. The furnace consists of two sections flanking a central combustion-chamber. Either can be cut-off from the combustion-chamber if required. The concrete foundation beneath each sec-



AT MURRAY, UTAH

tion forms eight individual chambers 9 ft. 2 in. deep and 6 ft. 6 in. by 13 ft. in area. These chambers are filled with water in which any ashes that pass the Wetherill grates accumulate. A ¾-in. feed-pipe, controlled by a valve operated from the charging-floor, supplies cool water just beneath the grate, while the overflow is immediately below the blast-inlet and 14 in. below the grates. The function of the water is to keep the grates cool, thereby preventing warping and buckling, which otherwise would be a continuous source of difficulty.

A water-tight door near the bottom can be removed to clean out the accumulation of ashes, which in time will become sufficient to be troublesome. The grates rest on I-beams, supported by the concrete; an 8-in. blast-pipe enters each chamber just below the grate-level. The arches are lined with fire-brick throughout, while common brick forms the outside walls. The top of the main arch is 8 ft. 6 in. above the top of the grates, while the small arches are 40 in. high and extend 3½ ft. into the furnace. These can be seen clearly in Fig. 5. The series of 'cracks' in the bridge-walls and in the roof of the arch indicate the allowance that is made for expansion when the furnace is heated. The furnace is substantially built and reinforced with buck-stays, of channel and I-beams and ⅞-in. rods. A firing or feeding-door is provided for each of the short arches, making 16 doors for each section of the furnace.

The early furnaces using the Wetherill process had doors along one side only, rather than two rows of doors opposite each other. While the present design has the disadvantage that the furnace cools more rapidly, this is probably more than offset by the greater ease with which the accretions can be removed when re-charging is being done. There is, of course, no back-wall and the absence of any obstruction makes the cleaning of the sides and of the grate itself more easy of accomplishment. The grates are cast-iron plates with tapering perforations ⅛ in. diameter on the top surface, spaced one inch in both directions. The combustion-chamber is a large brick chamber connected on either side by brick passages to the volatilizing sections of the furnace. In the sides of these passages are small arched openings like windows. These are checkered with brick masonry, and removable bricks are provided to permit the regulation of the flow of fresh air into the chamber.

Operation of the Furnace. The operation of the furnace, after once being blown-in, consists of drawing and re-charging in rotation at the individual doors. The procedure is as follows: The blast is cut off from the particular division that is to be cleaned and the door opened. The loose part of the last charge is raked off by hand and deposited on the floor to be re-charged later.

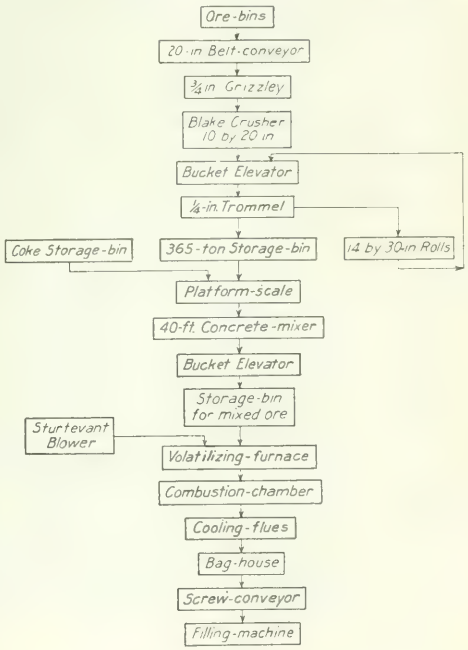


Fig. 2. flow-sheet

The semi-fused clinker is removed in a fashion similar to the cleaning of the fires under a coal-fired boiler, a slice-bar and rake being used for the purpose. The clinker is dropped through a hole in the floor to a car beneath, in which it is trammed to the dump. A layer of fresh coke-breeze is charged on the clean grate and the blast-gate is partly opened. The heat from the hot brick of the arch ignites the fuel and when it is burning briskly the ma-

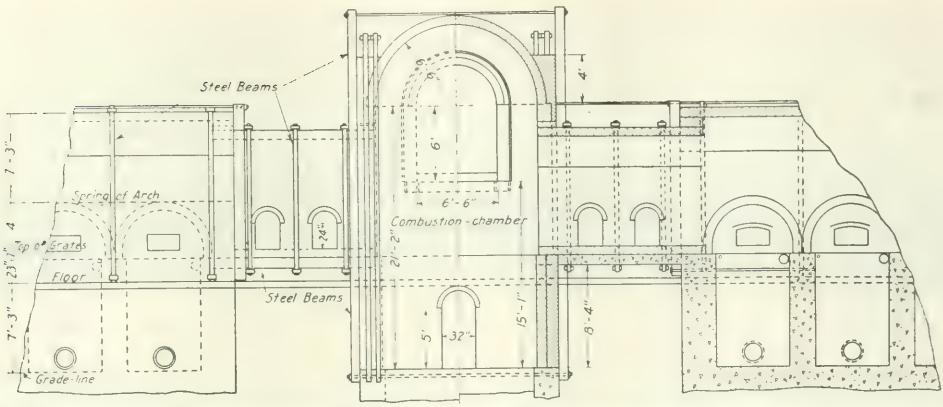


FIG. 3. ZINC-OXIDE FURNACE, SHOWING TWO OF THE EIGHT SMALL ARCHES ON EACH SIDE OF THE COMBUSTION-CHAMBER

terial saved from the former charge, with a quantity of mixed ore and coke from the charge-car, is shoveled into the furnace and spread evenly over the bed of fuel. The door is closed and the full blast turned on. The furnace-men then proceed to repeat the operation in the next division, and so continue around the furnace, working the 16 divisions in succession. In the presence of the coke the zinc is first reduced and volatilized; it is then oxidized on coming in contact with the excess of air in the large arch and in the combustion-chamber. A brick downtake conveys the fume-laden gas to a rectangular cooling-flue, also made of brick.

COOLING-FLUE. The blast is supplied by a No. 10 Sturtevant multivane fan with a capacity of 40,000 cu. ft. per minute at a speed of 460 revolutions. The pressure beneath the grate is equivalent to four inches of water. The cooling-flue is a circular sheet-iron pipe 45 in. diameter and 1000 ft. long. It is supported by low bents about five feet above the ground. A shorter flue is undesirable because it does not give the gases sufficient time to cool. Elbows and sharp turns are to be avoided because they offer unnecessary resistance to the flow of the gas. Expansion joints are provided each 30 ft., while at intervals of 8 ft. along the bottom of the pipe are small openings fitted with sliding gates where the oxide that settles may be withdrawn when necessary. The draft, however, is such that this accumulation does not amount to much.

The flow of the mixed fume and gas through the cooling-flue is effected by a 140-in. Sturtevant exhaust-fan situated at the end of the flue near the bag-house. This fan has a capacity of 70,000 cu. ft. per minute at 300 r.p.m. and creates a pressure of 1½ oz. per square foot in the effluent gas. The high temperature of the gas makes it necessary to have the bearings of the fan water-cooled.

BAG-HOUSE. The bag-house is 100 by 70 ft. The floor is of concrete and the foundation is a brick wall 22 ft. high. Surmounting this is the structural steel that forms the upper 19 ft. of the wall, and the trusses of the roof. At the top is a monitor running the entire length of the structure; it is 9 ft. high with extended eaves to prevent rain from entering the building. The monitor has no sides, and thus provides an outlet for the escaping gases. The accompanying photograph of the plant was taken before the bag-house had been covered.

Ventilation is one of the factors that govern the ratio of bag-area to grate-area; other things being equal, good ventilation will permit a considerably lower ratio.

There are 528 seamless cotton bags, 22 in. diameter

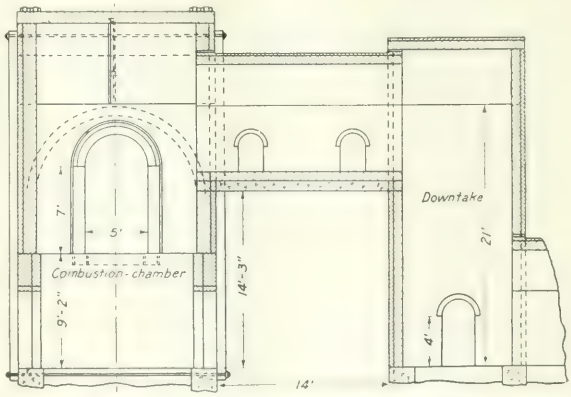


FIG. 4. SECTION THROUGH COMBUSTION-CHAMBER

and 28 ft. high. The fume-laden gas enters the bags from below, the distributing system being the same series of rectangular sheet-iron pipes that serve as collectors for the oxide. The principal header from the exhaust-fan runs along one side of the room; from it, at right-angles, run the distributing pipes, each of which serves a double row of bags. The open ends of the bags fit around circular collars on the distributing pipe while the upper ends are supported by short ropes suspended from a grill-work below the roof-trusses. There are two suspended walks between each two double rows of bags, one at the

level of the distributing-pipe system and the other near the top of the bags. The latter are used by the operators who shake the bags; under normal conditions this is done at intervals of 1 to 1½ hours. The bags are shaken by hand; a mechanical shaker would save labor, but, on the other hand, an experienced man will regulate the amount of shaking of individual bags, and can thereby keep them in more nearly uniform condition.

Satisfactory operation of a bag-house requires that the zinc-oxide fume be separated from the hot gases, the temperature of which fluctuates around 200°C., without excessive deterioration of the cotton cloth of which the bags are composed. To do this it is necessary to permit a coat of oxide to accumulate on the inside surface of the cotton tubing as a protection against the heat. If this coat is too thin the bags suffer; if too thick the obstruction to the passage of the gas is excessive and the amount of fume-laden gas that can be filtered is decreased. This condition will in a short time detrimentally affect the furnaces themselves. If the gases cannot escape, the volume and velocity of gas flowing through the cooling-flue decrease, and in a short time the draught to the furnaces will be reduced automatically. This slows the furnace and decreases the capacity with the coincidental poor recovery due to incomplete volatilization of the zinc in the ore. Too little protection also increases the possibility of fire, although in this plant the length of the cooling-flue is sufficient to preclude serious danger from this source. Careful regulation of the shaking, both as to frequency and thoroughness, is necessary to obtain the most satisfactory coating in the bags. A middle course must be taken, there being as much harm if the bags are shaken too frequently and too thoroughly, as if the interval is too long and work too hasty. Regularity is essential; the best operating conditions require that the resistance be uniform at all times.

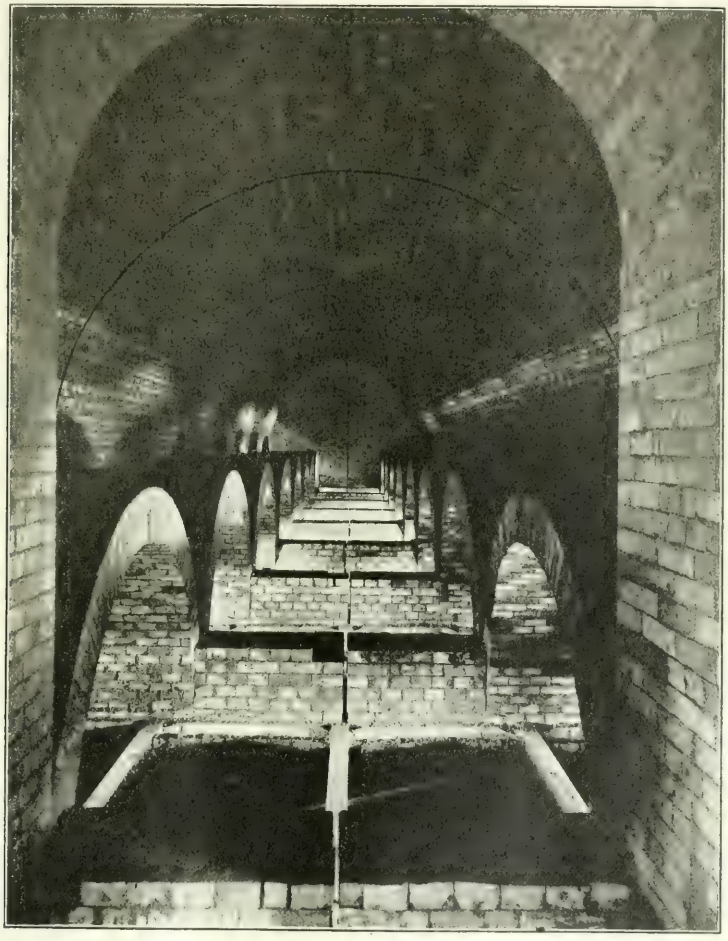


FIG. 5. INTERIOR VIEW OF ONE WING OF THE ZINC-OXIDE FURNACE

Dampers are provided to divert the flow of gas from the individual distributing pipes; they are closed in preparation for shaking. The ideal system is to have one set of bags in the process of shaking at all times. The oxide falls into the distributing pipe, the bottom of which is a series of steel hoppers shaped like inverted pyramids, there being one hopper for each four bags. Attached to the hopper is a collecting-sack made of duck, which rests on the floor with its mouth tied around a circular flange at the bottom of the hopper. These bags are detached daily, and with their contents are wheeled to a 9-in. extra-heavy screw-conveyor, which carries the precipitated oxide 70 ft. horizontally to the building where the packing is done. Here the finished product is elevated by means of an 8-in. bucket-elevator to a small storage-bin, from which it is drawn to the packing-machine. This device is borrowed from the flour-mill industry. It is known as the Nardyke & Marmon automatic power packer, capable of filling either 50-lb. paper bags or 300-lb. barrels. The packing-house also serves as a warehouse where several thousand barrels may be stored. Railroad-cars are switched on a spur-track alongside this building for convenience in loading.

A cooper-shop where barrels will be made is erected but not equipped as yet. An office-building, a machine-shop, and a store-house for operating supplies, an oil-house, and a transformer-station comprise the other buildings that are completed. I am indebted to James W. Wade, general manager for the company, for his courtesy in permitting these notes regarding the plant to be published.

The Fresnillo Mine and Mill

The following statement regarding the Fresnillo mining property in Zacatecas, Mexico, belonging to the Mexican Corporation is abstracted from a letter by William J. Cox to the directors of the Santa Gertrudis Co.: The estimate of 4,000,000 available tons within an area 1000 ft. by 300 ft. and of maximum depth of 200 ft. at the centre of the cone-shaped deposit, does not seem to me to cover a probable tonnage both below the line of estimate and laterally to the south. E. B. Kirby estimates 2,000,000 tons of additional probable ore in further depth, and, knowing him as I do, I have great respect for his judgment. The 'glory-hole' method of extraction of the surface orebody has been planned in every detail, and bears the stamp of approval of engineers eminent in this line of work. Then, too, the character of ground to be broken, the climate, and situation with reference to the point of delivery all appeal to me as naturally adapted to this method. While the mill-site is not ideal, it has advantages of convenient location to the mine, easy excavation, with good base for foundations, and ample area below for storage of tailing, on ground owned by the company. There will be considerable elevating due to little slope of the site, but the arrangement exhibits simplicity.

The foundations are practically finished, except as to the crushing plant, which is well under way. A brief description of the ore-flow follows: The broken ore will be drawn from chutes into 10-ton steel cars, and hauled in trains by electric locomotives to the car-tipple at the crushing-plant. In the crushing-plant the ore will be reduced in three passes to $\frac{5}{8}$-in. maximum size, using one 30-in. gyratory crusher, two 48-in. horizontal and two 48-in. vertical Symon's disc-crushers for this purpose. Thereafter, wet fine grinding to 75% through 200-mesh, will be done in six Marcy-type rod-mills, space being left for the addition of auxiliary tube-mills and for concentration equipment, if found desirable later on, especially in the treatment of sulphide ores. The finely ground pulp will flow to six Dorr-type thickeners, 60 ft. diam. by 10 ft. deep, and thence to 13 agitators of a modified Dorr type, 40 ft. diam. by 25 ft. deep. All these tanks are of redwood, and the great saving in room and cost of construction in the adoption of this type of agitator as against steel Pachuca tanks 15 ft. diameter by 45 ft. high, is to me an outstanding feature. After agitation, the pulp will pass to a Butters-type vacuum-filter plant, the tailing therefrom being pumped to the impounding dams. Precipitation will be accomplished by Merrill zinc-dust method with the recent Crowe vacuum improvement, in an enlargement of the present plant situated safely within the patio walls. Lime will be burned near the mill-site, the stone being hauled about three miles over a good road-bed to the oil-fired kiln. Water is obtained from the deep mine from which it is believed the supply will be ample. Power will be generated in a thoroughly up-to-date steam-plant consisting of oil-fired Stirling boilers, Westinghouse steam turbines direct connected to 60 cycle, 2300-volt alternating-current generators, having a total normal capacity of 6000 kw., with 50% continuous overload rating. This plant should supply ample reliable service for contemplated scale of operations and for future deep mining. The present cyanide plant is treating 400 tons of ore, but the recovery is only fair because of inadequate grinding and agitating equipment. The tailing-plant is yielding a moderate profit from 500,000 tons of residues from the old patio treatment.

Shale-oil was formerly produced in southern Germany, but production was killed by American competition. Today the high price of oil and the low exchange make resumption practicable. The production of lubricating oil from brown coal has attained great dimensions. It was begun in 1916 by the German Mineral Oil Co. at the suggestion of Mackensen at a time when the shortage of lubricants threatened to bring the whole war-machine to a standstill. Brown-coal lubricating-oil was first produced on a commercially profitable basis in 1918. The company mentioned has bought up several Central German brown coal mines and has put up a plant. Particularly good oil is being extracted from the so-called 'resin brown coal' of Thuringia, which yields 32% of tar. In Upper Silesia several companies are making brown-coal oils and the prohibition against the import of benzine has encouraged production of brown-coal benzine.

A Resume of Literature on the Theory of Flotation, With Critical Notes

By H. R. Adam

*In the following paper I propose to give a summarized version of the theoretical information that has accumulated within the last five or six years in connection with flotation processes for the concentration of ores. Papers on this subject have appeared chiefly in the scientific and technical journals devoted to mining and metallurgy, although it is noteworthy that physicists are now becoming more directly interested. Naturally the written information obtainable on both the practical and theoretical aspects of flotation is still very much scattered and as several important contributions to theory have been published without discussion or criticism it is by no means an easy matter to compare the data available or the statements founded thereon. The matter in this paper is classified not according to dates on which publications have appeared, but according to what have seemed to the writer to be the different phases of the subject, and in adding critical notes he is giving in a general way the results of his own observations and experimental work. For the sake of clearness it was thought advisable to include a good deal of what may be considered by many to be rather elementary and out of date information.

Conditions for Equilibrium when a Solid is in Contact with Two Fluids. These are the apparent conditions in a mixture of ore particles and water during the application of the various methods of flotation; the ore particles represent the solid, while the fluids are water, more or less modified by the addition of various 'reagents' and gas or gases, the latter in the form of minute bubbles. Before examining the statements of writers on flotation theory under this heading the equation representing the equilibrium as given by Clerk Maxwell[1] should be studied. "The equilibrium of the tensions concerned depends only on that of their components parallel to the surface because the surface-tension normal to the solid surfaces are balanced by the resistance of the solid. Hence for equilibrium.†

$$T_{sg} - T_{sl} - T_{lg} \cos\theta = 0$$

$$\text{whence } \cos\theta = \frac{T_{sg} - T_{sl}}{T_{lg}}"$$

Poynting and Thomson[2] deduce a similar equation.

Edser[3] arrives at a similar result, although in a somewhat different manner. His reasoning is especially interesting, since he assumes that the tension T_{sl} is a residual tension. "When the liquid comes in contact with the solid the surface of the solid will be partly relieved of its strain by the attraction of the liquid molecules and similarly with the liquid molecules. Therefore when wetting takes place $T_{sl} = 0$, e.g., water/glass. When there is absolutely no wetting $T_{sl} = T_{sg} + T_{lg}$ and $\theta = 180°$, cos θ in this case being -1; such a condition is approached by the contact of mercury and clean glass."

Edser, therefore, assumes that T_{sl} simply depends on T_{sg} and T_{lg}; this is doubtful, since new conditions may arise on account of chemical or electromagnetic action at the solid-liquid surface or interface.[4] According to Hatschek[5] there is no proof that in suspensions T_{sl} can be reduced to zero.

It will be seen from Clerk Maxwell's equation that an increase in the angle of contact means that T_{sl} increases relatively to T_{sg}. If we look at the matter from the aspect of the principle of minimum potential energy it becomes clearer. The greater T_{sl} the greater will be the tendency to reduction in the area of contact of solid and liquid, and it follows that θ will increase; conversely, if T_{sg} is large the tendency will be toward a reduction of the interface solid-gas, which can be done by the spreading of the liquid with consequent decrease of θ.

The following applications of this theory to flotation have been made:

O. C. Ralston[6] and Corliss and Perkins[7] state the relationships in the form used by Freundlich[8] for the distribution of collodial particles in two liquid phases.

Since Ralston confines his statement to two liquid phases, oil and water, and since in modern flotation it is probably more correct to consider only the two fluid phases "contaminated water" and gas—only the statement according to Corliss and Perkins need be repeated.

These writers state that either

(1) $T_{sl} > T_{sg} + T_{lg}$

or (2) No one interfacial tension is greater than the sum of the other two.

They further state that the condition (3) $T_{lg} > T_{sg} + T_{sl}$ is imposible and that case (2) is the actual one in flotation. For complete wetting of gangue, for example, the condition is $T_{sg} > T_{sl} + T_{lg}$; while conditions (1) and (3) would imply complete non-wetting.

This argument is in accordance with the Clerk Maxwell equation, but it must be pointed out that condition (2) implies that a triangle could theoretically be constructed with sides proportional to the three tensions. According to Clerk Maxwell, both experimental work

*From the Journal of the Chemical, Metallurgical and Mining Society of South Africa.

†In order to avoid confusion the symbols used by various writers, which naturally vary, have been put in the one form.

T_{sg} = surface-tension solid-gas.
T_{sl} = surface-tension solid-liquid.
T_{lg} = surface-tension liquid-gas.
θ = the contact-angle.

and theoretical reasoning support the view that this condition is imaginary and where it apparently occurs, one or more of the surfaces is contaminated; that is, where spreading of the liquid does not occur we are not dealing with true contact of the surfaces. It is, however, probably quite justifiable to consider the case in the manner of Corliss and Perkins, since in flotation the surfaces almost certainly are contaminated, but due consideration of the matter is important in view of the discrepancies in the results obtained for contact-angles, to be mentioned later.

Taggart and Beach[9] state the equilibrium equation as

$$T_{s1} = T_{sg} + T_{lg} \cos \theta \text{ from which}$$

$$\text{Cos } \theta = \frac{T_{s1} - T_{sg}}{T_{lg}}$$

This means that a large contact-angle will be the result of a low T_{s1} and relatively high T_{sg}, that is, a tendency for the liquid to wet the solid, which is obviously incorrect. Sulman[10] gives the relationship in the manner of Edser,[3] and evidently regards the tension at the solid-liquid interface as a residual tension greater or less according as wetting is partial or complete. Sulman's explanation of the matter is made the more lucid since he discusses the various possibilities according to the variation of the contact-angle between 180° and zero.

In a paper on the theory of wetting, Cooper and Nutall[11] state the equilibrium equation and give a clear explanation of the conditions that may obtain. As these writers have approached the matter from an entirely different standpoint from that of flotation, it is of interest to summarize their article even at the risk of considerable repetition. They quote Quincke as being the first to state the conditions for wetting which, using the same symbols, are:

(*a*) That T_{lg} should be low.
(*b*) " T_{sg} " " high.
(*c*) " T_{s1} " " low.

Cooper and Nutall emphasize that in regard to wetting it is not sufficient to regard only the surface-tension of the liquid, since even though T_{lg} be high, wetting may occur if T_{s1} is low. The factors influencing T_{s1} are:

(1) The chemical or solvent action of the liquid on the surface layer of the solid; (2) adsorption of dissolved substances at the liquid surface, which occurs when such a concentration causes a decrease in the surface-tension of the liquid. The point made with regard to this adsorption is that it is accompanied by increased viscosity at the surface, and that there appears to be a close connection between superficial viscosity of liquids and their wetting power for solids; further reference to this will be made in a later paragraph. From the point of view of flotation the value of the work of Cooper and Nutall lies chiefly in the emphasis laid on the interfacial tension T_{s1}. In the cases which they are considering, namely, the wetting power of dips and insecticides, the possibility of chemical or solvent action at the solid-liquid interface is obvious. In flotation the complexity increases, and we have to consider possible factors influencing T_{sg} and T_{lg}, while the work of Langmuir and Harkins already referred to indicates that new conditions may arise at the solid-liquid interface affecting T_{s1}.[5]

The Contact-Angle. From the foregoing discussion of the equilibrium equation it is clear that the contact-angle is practically the only quantitative guide to the relative tensions. It may be remarked at once that from the practical point of view, measurements of contact-angles are probably of little value in flotation. Even with the utmost precaution against contamination physicists are unable to arrive at close agreement, and it is evident that the most minute alterations in the conditions obtaining at the surfaces of the three phases may affect the angle considerably.

Freundlich[8] expresses considerable doubt on the question of contact-angles and states that where a positive angle is obtained it may be due only to contamination of the surfaces. He further states that it is generally concluded that complete wetting means a zero contact-angle. In the case of metals, however, the evidence is in favor of a positive angle though the results are in such poor agreement that they can hardly be relied on quantitatively. In the case of glass and water it appears almost certain that if a clean surface is dealt with the angle is zero; for metals Kaye and Laby[12] give the angle as varying between 3° and 11°.

To the writer's knowledge the only two papers on flotation theory giving data on contact-angles are those of Corliss and Perkins[7] and Sulman[10]. The former contributors do not attempt direct measurement of the angles but give the related values of the rise of the meniscus of the liquid against the mineral surface.

For pure water, taking the rise against the surface of the silicate (which silicate is not mentioned) as unity, the rise against chalcocite is 0.5, and for chalcopyrite 0.8; for 0.1% H_2SO_4 the ratios are, silicate 1, chalcocite 0.6, chalcopyrite 0.8, and for 0.1% NaOH, silicate 1, chalcocite 0.9, and chalcopyrite 0.9. Corliss and Perkins also found that when the second fluid was an oil-mixture such as is used in flotation, instead of air, the contact-angle of the mineral with the water was over 90°.

The most recent figures for the contact-angles of minerals and water are given by Sulman.[10] It is stated that minerals have a maximum and minimum angle with water and the difference between the maximum and minimum is called the 'hysteresis'. Sulman states that the hysteresis has important effects in flotation. The most noteworthy points in Sulman's investigation are (1) The magnitude of the angles, for example:

	Minimum	Maximum
Stibnite	24.0	62.8°
Calcite	39.6°	85.5°
Glass	33.0°	39.5°
Quartz	19.5°	58.5°
Chalcopyrite	37.0°	87.0°
Galena	35.0°	73.0°

(2) The small differences between two such minerals as quartz and stibnite (stibnite is one of the most easily floated sulphides).

(3) The hysteresis—Corliss and Perkins[7] also refer to this hysteresis and suggest an explanation on the basis of

the smoothness of the mineral surface. Sulman refers to a "molecular interlocking of the liquid and the solid".

In view of the doubt regarding contact-angles, Sulman's figures are distinctly surprising and can hardly be accepted as final, although it is stated that the figures have been confirmed by two different methods. The writer has made several attempts to arrive at satisfactory conclusions for the contact-angles of a few minerals with water. The results obtained were somewhat varied, but, on the whole, indicated that when examination is made immediately after immersion in water the contact-angle is either zero or very small in the cases of chalcopyrite, galena, marcasite, stibnite, quartz, and calcite. The faces examined were, however, not natural cleavage-planes but surfaces obtained by polishing with a fine jeweller's file. There is, however, a distinct difference in the behavior of these minerals. The sulphides only give the zero angle if examined directly after being immersed in water; if the surfaces are merely touched with a piece of filter-paper and then examined again, positive contact-angles up to 90° or more are easily obtained. The inferences is that sulphides 'adsorb' films of air or oxygen with extreme rapidity and in this condition resist the spreading of the water to a greater or lesser extent. It is hoped to give the method of procedure and more detailed results of these investigations at a later date, at present the results are hardly conclusive.

Adsorption of Gases at the Surfaces of Minerals. Although several writers on flotation—Rickard[13], Sulman[10]—have stated that the adsorption of gases on mineral and metallic surfaces is of minor importance in flotation, the evidence in experimental investigations is to the contrary, at least as far as theoretical explanations are concerned. The probabilities are that the tendency which nearly all solids show to condense or adsorb gas on their surfaces is closely connected with the variability of the contact-angle and consequently with the interfacial tensions of solids with liquids and gases. It is true that oil is used in nearly all recent flotation methods, but there is no reason to suppose that this involves great changes in principle since the essential features can easily be manifested without oil. The fact that oil or oils are necessary in practice has tended to obscure the main problem, which is the cause of the preferential adhesion of gas bubbles to sulphides and metals. Unfortunately the knowledge of the causes and effects of gas adsorption on solid surfaces is very limited. Sulman states that "Edser has disproved the air-film theory since such a condensation must involve a considerable quantity of gas . . . readily appreciable by chemical and physical means." He further states that

"(1) Pure air is not condensed to any appreciable extent on blende, quartz, or galena.

"(2) That CO_2 is minutely adsorbed.

"(3) That a gas-free mineral floats at an air-free water surface, that is, in vacuo, with the same ease as at a water/air surface."

These statements are of a controversial nature. It is well known that solid surfaces, particularly metals, do adsorb or condense appreciable quantities of gases and although this property is not commonly referred to in the specific case of minerals, it is not likely that the latter are peculiar in this respect. In any case there is abundant evidence of a less exact nature that sulphides especially, do adsorb gases readily and that the gaseous films are extremely difficult to remove.

Whetham[14] remarks on "the film of condensed gas which seems to exist on all solid surfaces and to be so difficult to remove". He further refers to the work of Brown, Spiers, and Erskine-Murray, on the effect of such films on the potential difference at the surfaces of metals and electrolytes. "Erskine-Murray has shown that the potential is increased by polishing and reduced by oxidation." Whetham concludes "that there would certainly be less affinity between a gas and a partially oxidized metal than between a gas and a clean metal".

Harkins[4] states "Since the flotation process depends on the preferential wetting and adhesion of gas films to metals and sulphides on the one hand and silica and similar substances on the other . . ."

Langmuir[4] refers to the adsorption of gases on solids in connection with the theory that such adsorbed films are in a form of chemical combination with the atoms of the solid surfaces.

Taggart and Beach[9] refer to the density of gas layers adhering to solids.

In view of such statements as these and many others, it is impossible to dismiss the phenomena as being of minor importance in flotation.

There are several empirical facts of more direct interest to be recorded with reference to this question.

Mickle[15] noted the remarkable pertinacity with which gas adheres to certain minerals. He recorded how zinc and lead sulphides could be made to continue to float by simply heating in water. He assumes that the gas in this case is air and that at each boiling fresh air films are obtained at the surface. Mickle also records similar observations in the case of CO_2 derived from the action of dilute acid solutions on ore particles containing carbonates. He notes particularly the effect of heat on the flotation of sulphide particles by means of CO_2 bubbles. Mickle's work was carried out on zinc and lead sulphides; I have confirmed his results frequently on ore-samples from the Murchison Range district, of the Transvaal, and on Rhodesian gold ores containing antimony sulphide and arsenical pyrite. These investigations, of course, are based on the well-known Potter-Delprat flotation process. If the slightly acid solution in which a mass or froth of sulphide particles has been floated, is allowed to cool, much of the froth will break up and the particles will sink; on heating again the froth will be reformed. In the case of CO_2 bubbles, this can be repeated almost indefinitely although at each heating one notices a tendency for the froth to become less stable. In the case of air, the froth formation is not nearly so permanent, and usually with two or three boilings, wetting appears to be complete. It is difficult to interpret such observations unless we assume that even after repeated boiling there are still adherent films of CO_2 gas. It is possible that after heat-

ing and cooling several times, the bubbles which attach themselves to the sulphide particles consist chiefly of water-vapor. As a result of numerous observations on antimonial ores, however, I am inclined to think that the efficacy of the Potter-Delprat method is chiefly due to the fact that, at or near boiling-point, the gas bubbles are given off in just the right condition for successful flotation—that is—as a continuous stream of innumerable bubbles of minute size, providing a relatively enormous surface and not rising too quickly through the liquid.

Henderson[17], in a paper on flotation at Broken Hill, refers to some recent methods of differential flotation devised by Bradford. These methods have a direct bearing on the question of gas adsorption at sulphide surfaces. It is claimed that by generating such soluble gases as hydrogen sulphide and sulphur di-oxide at the mineral surfaces, air films, which are assumed to be adhering, are selectively removed so that, by small alterations in the acidity and temperature of the liquid, selective flotation can be carried out. It is stated that these methods are commercially successful and they serve to emphasize the importance of gas films in the theory of flotation. In some experiments on the flotation of stibnite ores by CO_2 bubbles, I have found that by passing large air bubbles into the mixture the floating mass of sulphide particles is broken up and the particles readily sink; on heating again the flotation takes place as before, so it is assumed that the effect of the air is chiefly mechanical. According to Freundlich[8] the nature of the gas is of more importance in determining the amount of adsorption which will take place than the nature of the solid. This is not altogether in agreement with such evidence as is available in flotation investigations, but it may be remarked that Freundlich's statement is apparently based on experimental results on such porous solids as charcoal, meerschaum, etc. The fact that carbon di-oxide is more difficult to remove than air is however in accordance with Freundlich's statement that the more easily liquefied gases are more strongly adsorbed.

Froths and the Effect of Oil. This phase of the subject has been dealt with very fully by several writers on flotation theory including Rickard[15], Hildebrand[18], Taggart and Beach[6], and notably Sulman[10]. The conditions for a stable froth are clearly set out in works on colloidal chemistry. Lord Rayleigh[19] has shown that frothing is always associated with contamination; in fact, in comparison with other features of flotation the stabilizing of the froths is thoroughly well understood. It is of special interest to note, as has been done by Sulman and others, that the mineral particles themselves may provide the stabilizing conditions; this is what is meant by the term 'armoring' of the bubbles. Thus it may be shown in many cases that when only a small proportion of sulphides is present in an ore these may float but be unable to form a coherent froth since there is insufficient armoring. With an ore-sample containing exactly the same constituents, but a larger proportion of sulphides, a comparatively stable froth may be obtained. Sulman states that the surface-tension of water is considerably lowered by the presence of mineral particles. If this is correct it may partly explain the fact mentioned by Mickle[15], Henderson[17], and Hoover[20], also confirmed by the writer on stibnite ores[16], that the presence of much slime in flotation without oil gives uniformly unsatisfactory results.

It is well known that it is easy to overdo the addition of what are called 'frothers' in flotation and to obtain a 'barren' froth (Sulman, Rickard, Corliss, and Perkins). The reason generally given is that the surface-tension liquid-gas has thereby been so greatly lowered that the wetting tendency is increased. In the discussion on the equilibrium equation, however, it was shown that wetting power depends on other factors than the surface-tension of the liquid, notably the viscosity.

In most of the papers on flotation theory already referred to, the effects of the oil additions are fully discussed. The main effect, although there is no definite evidence on the point, is that the oil spreading rapidly over the sulphide surfaces forms films of extreme tenuity, with the result that the characteristic properties of the sulphide surfaces, as far as the adhesion of gas bubbles is concerned, are so greatly enhanced that practical flotation depends chiefly on these small additions of suitable oils. Sulman gives figures showing greatly increased contact-angles for oil-filmed minerals in 0.7% sulphuric acid.

Additional Bibliography. Owing to the method on which this summary of flotation literature has been prepared the references on the subject cannot claim to be complete.

For much useful information, both on the theory and practice of flotation, the columns of the 'Mining and Scientific Press' for the the last five or six years should be consulted. Most of the articles which have appeared in that journal are collected in a convenient volume edited by T. A. Rickard.[21] The books on flotation by Hoover[20] and Megraw[22] also contain chapters on the theory of the subject. The effort required to follow the voluminous reports of legal proceedings over flotation patents is not likely to yield sufficient reward to make it advisable. For a non-mathematical treatment of surface-tension the reader is referred to 'Surface Tension and Surface Energy' by R. S. Willows and E. Hatschek. The most noteworthy contribution to flotation theory which has recently appeared is that by H. L. Sulman, which has been several times referred to. His paper contains a vast amount of valuable information and several portions of it are criticized in the discussion which followed.

Truscott[23] questions the application of the term 'adsorption' to the adhesion of sulphide particles to gas bubbles and the use of the term 'suspensoids' for a mixture of ore particles and water. He questions if there is any fundamental difference between film and froth flotation.

Porter[24] criticizes Sulman's idea that a zero contact-angle is not accompanied by complete wetting and questions the extremely high value for the contact-angle water glass.

Hatschek criticizes Sulman's statement that complete wetting means a reduction of interfacial tension to zero

and points out that far-reaching conclusions are based on very meagre experimental evidence.

It is impossible to summarize satisfactorily this important paper, but there are portions not already referred to which should be mentioned. Sulman insists on the importance of 'flocculation' in flotation, and states that in order to be floated the mineral must first be 'flocculated'. Flocculation has been considerably studied in connection with the settlement of slime—Free[3]—but in articles on flotation I have found the term used only in the paper by Corliss and Perkins. The latter, although not very lucid on the matter, apparently conclude that flocculation is harmful in flotation since the aggregates formed may consist of silicious gangue particles which may float with the sulphides. If Sulman's statements are interpreted correctly, however, the trend in flotation practice is to float preferentially almost any desired mineral by causing it to flocculate; this is to be done by various modifying physical and chemical factors. These ideas are in all probability the result of the wide application of flotation to the treatment of 'slime', which is commonly classed as a colloidal solution. The natural inference to be drawn from Sulman's paper is that there are considerable differences in principle between the methods of flotation he chiefly refers to, and what may be called the film-flotation of comparatively large particles which, as has already been mentioned, is best accomplished in the absence of slime. Possibly this theory of flocculation accounts for the fact that the concentrate obtained by the Minerals Separation methods seem generally to contain a high proportion of gangue.[26] A further important feature of this paper is the reported effect of acidifying the liquid. It is stated that the contact-angles are generally lower in acid solutions; from this it would probably follow that the surface-tension of water is decreased by the addition of acids. Taggart and Beach confirm this to some extent, but according to Taylor[27], also Kaye and Laby,[12] the effect of the acid is to slightly increase the surface-tension of water. The most obvious effects of adding acid, in the writer's experience, are that the sulphide surfaces may be freed from oxide films (this is particularly noticeable in the case of banket ore containing pyrite), and that an additional supply of gas bubbles may be provided in cases where carbonates are present.

Concluding Remarks. As a result of the commercial success of flotation, many new facts have been learned empirically regarding the physical and chemical properties of surfaces. Exact experimental data are however required before sound generalities can be established. It seems to the writer that a statement such as the following is, at present, as much as is justifiable. A tendency for such surfaces as those of metals and mineral sulphides to adsorb and retain films of gas or grease to a greater degree than the surfaces of substances such as quartz and silicates is generally indicated. Such adsorption, according to the theory of adsorption in liquids, must be a manifestation of greater surface energy in the case of the former substances. Having obtained such films, the solids must be regarded as contaminated, and we no longer have true contact between the solid and the two fluids; the energy of the solid surface being reduced to a minimum by such adsorption, the surface energy liquid/gas is manifested by a decreased adhesion of the liquid to the solid, with the result that the gas bubbles cling more or less tenaciously to the solid surface. The aggregations or 'floccules' of gas and solid particles thus formed may in certain circumstances sink, but in most cases will rise, owing to the great volume of adhering gas.

If it is true that such metallic surfaces have this greater surface energy, such a fact suggests a connection with the fact that metals and sulphides more readily undergo chemical transformation than quartz, silicates, and oxides generally.

It is somewhat disheartening to the metallurgist on taking up the study of flotation theory to find that the obtaining of experimental data is really a matter for the physical laboratory and that the interpretation of results is by no means easy. Hatschek, in discussing Sulman's work, speaks rather sarcastically of the mass of empirical information imparted and the explanations given of the facts. The assembling and reporting of observations of a purely empirical nature must, however, be of great importance in the construction of a general theory. In actual fact the litigation that has taken place over flotation has, among other things, demonstrated that even among physicists, there is almost complete ignorance as to the real meaning of the phenomena that attend the wetting of a solid by a liquid. Hatschek himself admits this,[5] and suggests it may be due to "a lack of any important problems involving a closer knowledge of these factors". The fact is, however, that the importance of a theoretical study of the phenomena concerned, is not by any means confined to flotation. The references to Whetham's 'Theory of Solution', and to the article by Cooper and Nutall on 'The Theory of Wetting' in connection with dips and insecticides should make this clear.

There are similar problems involved, in the soldering and welding of metals, in the amalgamation and cyaniding of gold, and of even more direct interest on the Rand they have an intimate bearing on the difficult questions concerned in the settlement of fine floating dust particles underground.[28]

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[1]Clerk Maxwell, 'Capillary Action', Encyclopedia Britannica, 11th edition, Vol. 5, pp. 261-263.

[2]Poynting and Thomson, 'Properties of Matter', p. 140.

[3]E. Edser, 'General Physics'.

[4]Langmuir, Jour. Am. Chem. Soc., 1916, and 'Met. & Chem. Eng.', Oct. 15, 1916; also McLewis, 'The Chem. Theory and Capillarity', 'Science Progress', April 1918. Harkins, Proc. Nat. Acad. of Sciences, December 1919.

[5]E. Hatschek in discussion on Sulman's 'Contribution to the Theory of Flotation', Bulletin, I. M. M., January 1920.

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[11]W. F. Cooper and W. H. Nutall, 'Jour. Agri. Sci.', Vol. VIII, 1915-'16.

[12]Kaye and Laby, 'Physical and Chemical Constants'.

[13]T. A. Rickard, 'M. & S. P.', July 14, 1917.

[14]Whetham, 'Theory of Solution', pp. 269-272.

[15]K. Mickle, 'E. & M. J.', Aug. 1911 and July 1912.

[16]H. R. Adam, Jour. C. M. and M. S. of S. A., June 1915.

[17]E. Henderson, 'M. & S. P.', Sept. 21 and 28, 1918.

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[19]Lord Rayleigh, 'Lecture on Foam', Proc. Royal Inst., March 1890.

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Recovery of Gold From Black Sand

By JOHN GROSS

*Introduction. The Alaska Station of the Bureau of Mines has recently conducted tests on two tailings from black sand which had been treated previously at the Station. The results of this previous treatment have been given in a paper entitled 'Recovery of Gold from Black Sand by Classifier Concentration'.

The gold in these tailings was intimately united with quartz, and was so finely divided that it could not be detected with the naked eye, nor even by panning unless the material was ground. Its fineness is further shown by the assay result, which reported only 12% of the gold content as metallic, whereas the assay of the original sand reported 36% of the gold as 'metallics'. The fact that the gold was in such fine particles, closely united with quartz, precluded further recovery by amalgamation without grinding. On the other hand, the small content present, as well as the lack of grinding appliances at the placer mines of Alaska, made it necessary that the material be cheaply handled if at all. With these facts in mind the experiments described below were undertaken.

Coarse Tailing. This tailing had been obtained by amalgamating the concentrate produced by classifier concentration. The tailing was screened on a 28-mesh screen; the oversize was hand-jigged on a six by six-inch screen, resulting in a concentrate and a tailing; the undersize was passed over a canvas table, resulting in a concentrate and a tailing. The results of this experiment were as follows:

	Weight lb.	Weight %	Assay gold oz. per ton	Contents gold oz.	Contents gold %
Jig concentrate	6.4	5.6	26.25	0.0813	36.4
Jig tailing	67.4	61.4	3.46	0.1168	52.3
Canvas concentrate	4.7	4.3	2.13	0.0050	2.3
Canvas tailing	31.6	28.7	1.27	0.0201	9.0
	110.0	100.0	4.058	0.2232	100.0

From these results, evidently a fair degree of concentration may be obtained in the coarser portion but not in the finer. A test showed that the gold in the jig concentrate can be recovered by amalgamation if the concentrate is previously ground, but without grinding, the recovery is negligible.

Fine Tailing. This tailing had been obtained from the concentration of minus 30-mesh material on a canvas table. The tailing was again passed over a canvas table, the aim being to produce a small amount of concentrate. The results obtained are as follows:

	Weight lb.	Weight %	Assay gold oz. per ton	Contents gold oz.	Contents gold %
Canvas concentrate	11.4	5.4	9.89	0.0564	46.6
Canvas tailing	198.6	94.6	0.65	0.0646	53.4
	210.0	100.0	1.15	0.1210	100.0

These results show that an additional recovery can be obtained on this material by a second treatment on a canvas table, or probably by the use of a long canvas table. A test showed that an excellent recovery can be obtained on this concentrate by amalgamation in a revolving barrel, but whether barrel-amalgamation would pay on such low-grade material is doubtful.

Conclusions. These experiments demonstrate that on material of this nature an enriched product may be obtained by hand-jigging the coarser sand and by canvas-table concentration of the finer sand. The enriched product of the coarser sand is worthless unless ground and amalgamated. If produced in sufficient quantity, however, it could be profitably shipped to a smelter. In the placer mines of Alaska the amount of black sand produced by each operator generally is small. Treatment for recovery of any gold not ordinarily obtained by classifier and canvas-table concentration followed by barrel-amalgamation of the resulting concentrates, would be profitable only when handling large amounts of black sand. The gold in the enriched product of the finer sand can be recovered by barrel-amalgamation.

*The author is metallurgist for the U. S. Bureau of Mines, which issues this information.

About 600 tons of cadmium accumulates annually in this country as dusts and residues, by-products of the lead and zinc industries, and about 100 tons of metallic cadmium is recovered from these by-products. If all the cadmium dusts and residues were treated, the output of metallic cadmium would be small in comparison to the 19,000 or 20,000 tons of tin annually used in this country in solder, even if due allowance is made for the fact that one pound of cadmium can replace from three to five pounds of tin. Various formulas proposing the substitution of cadmium for tin in solders are given. On the whole, American experience with cadmium solders is promising, and their use for certain purposes seems fairly established. It is known that solders with 10% cadmium and 10% of tin can be used, and that the cadmium content has frequently ranged as high as 30% with 2% of tin.

Asbestos from Rhodesia is of high quality and is much in demand by American consumers. Production in Rhodesia was first reported in 1909 when 272.5 tons was produced while in 1919 the output was 9799 tons.

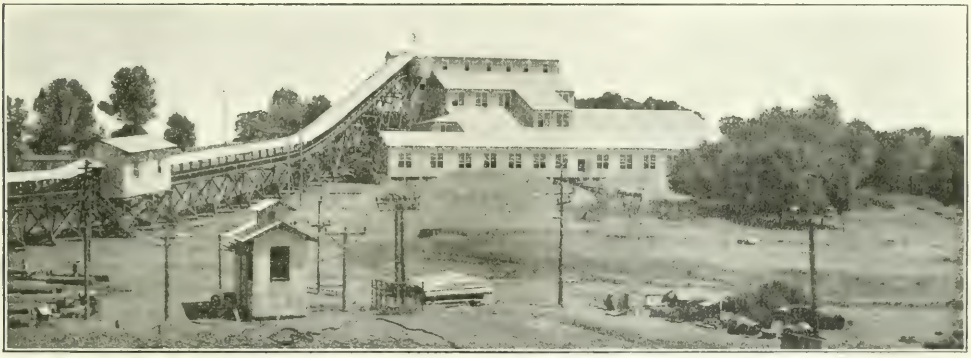
Re-Opening of the Plymouth Mine and the Results

By W. J. Loring

In 1911 the above property was re-opened by the California Exploration Company, Ltd., which was organized for this special purpose.

During a visit to this country from London in 1911, I was asked by Mrs. Charles D. Lane if I would look into the matter of acquiring a property then optioned to Albert Burch. Subsequently, I took over the option from Mr. Burch, and Messrs. Bewick, Moreing & Co., mining engineers of London, through me as their partner formed the California Exploration Company, Ltd., to which the option was assigned, and work commenced under the able supervision of Mr. Burch, who for several years represented Messrs. Bewick, Moreing & Co. in California.

James F. Parks was appointed superintendent, which position he held, with distinction to himself and satisfaction to his company, up to the time of his death last June.



THE PLYMOUTH STAMP-MILL

Unwatering and equipping were commenced late in 1911 and completed on July 30, 1914, at which date the new 30-stamp mill began operations after an expenditure of $960,000. It will be remembered that war was declared by Great Britain on August 4, 1914, less than one week after the new mill started; therefore, the mine was operated for about three years before the United States entered the War.

The first two years working cost averaged $2.90 per ton. This first figure has grown steadily until for the first eight months of 1920, the cost, excluding development, has averaged $4.97 per ton, but, including development, $5.99 per ton. The total tonnage treated for six years and one month to August 31, 1920, totaled 732,745, from which $4,035,932 has been recovered. The profit over all expenditure has been $1,119,581. This latter figure would have been greatly increased if it had not been for war conditions, which increased the cost of operating and retarded development to such a point that it was feared not many months ago that the mill could not be kept supplied with sufficient ore.

A word about what was found when the water was first taken from the mine. The vertical shaft, known in the early days as the Pacific shaft, was 1600 ft. vertical, and when the California Exploration Company began to unwater the mine, the water was running from the collar of the shaft; therefore, all of the workings were under water. The mine had not been operated for 24 years, but even after this long period of idleness, and taking into consideration the fact that the main vein of the Mother Lode passed through the shaft just below the 1200-ft. level, no considerable amount of repairing was necessary to reach the 1600-ft. level, which was the bottom of the shaft at that time. About fifty sets of timber in the shaft had to be renewed, which cannot be considered excessive under the circumstances.

Examination of the 1600-ft. level disclosed the fact that an eastern cross-cut, 140 ft. long, had intersected the main vein, which had been driven upon 160 ft., without finding any ore. An old winze was discovered below the 1600 level, 75 ft. deep, and the bottom of this winze, upon being cleaned out and sampled, disclosed 28 inches of quartz assaying $17 per ton. This winze was continued to the 2000-ft. level, all in ore, at which point 160 ft. of drift was completed, all in ore, and at the same time a drift south on the 1600 disclosed 260 ft. of ore similar to that uncovered in the winze, averaging about $6.35 per ton. In all, about 110,000 tons of ore was reasonably in sight with good bottoms and fairly good ends, on the 1600 and 2000-ft. levels, with an intermediate level at the 1850, all of which averaged around $6.35 per ton.

It was evident that a zone of enrichment or recurrence of ore had been encountered below the 1600 in the new workings, this being a repetition of the results obtained

in other mines along the Mother Lode, all of which had been sunk to greater depth than the old Plymouth had reached, and all of which had encountered zones of impoverishment and enrichment, and upon this experience I recommended the purchase of this property.

It was considered by some prominent engineers at the time, especially in London, that it was not good policy to purchase a mine with barely 110,000 tons of ore in sight, having a gross value of no more than $6.35 per ton, and at best not over $2 profit per ton, but having regard to the records of the other large mines on the Mother Lode, which had encountered, mine after mine, better ground by deeper sinking, it was my opinion that the purchase would be profitable to the shareholders.

The result was that the mine has gone on producing ore profitably until early 1920, when several disappointments were encountered in the nature of several orebodies in the mine giving out at depth; and owing to the fact that labor has been scarce, due to war conditions, the development of the mine was retarded to such an extent that shaft-sinking was slow and for a time it looked as if the mill would have to stop operations about the end of 1920.

By making a special effort to get the shaft down below a poor zone encountered at the 2450-ft. level on the main vein, the shaft was extended from level to level until it reached 3050 ft., but before reaching this point, lateral developments disclosed the fact that one or two of the big ore-shoots had given out, or at least they did not extend to the levels immediately below; and as labor was scarce, it was considered advisable to get the shaft down with all possible speed with the hope of a recurrence of ore on the main vein, which, after all, on the Mother Lode is the one that produces the ore in large quantities when found, and the one vein that is to be relied upon more than the foot-wall veins.

The main vein at the 2450 was poor, at the 2600 unpayable, at the 2750 unpayable, then the shaft was sunk 300 ft. to the 3050, and when the last shot was fired in the sump a small vein across the north-east corner of the shaft was uncovered; it assayed $52 per ton. The shaft was deepened another ten feet, making it 60 ft. below the 3050 level, which was subsequently opened, from which point a preliminary cross-cut east was driven, and a vein ten feet wide, assaying $10 per ton was intersected. Then the 2900 level was opened and afterward the 3050 level. The 2900 encountered the main vein, which has been driven upon for some considerable distance, without finding any well-defined ore-shoot, although encouraging assays have been obtained in one or two places.

The 3050 level was opened and the distance between a foot-wall gouge and a hanging-wall gouge represents about 35 ft. Half this distance was veined with quartz, assaying considerably over $10 per ton. Drifting upon this vein was commenced, going south; it gave out at 40 ft. without being faulted, and it is believed that a shoot of ore will be found southward, in which direction the drift is now being advanced.

Drifting northward, the vein narrowed until it was only two feet wide, but the assays continued to improve and at 103 ft. the vein is over 12 ft. wide, and the car-samples average considerably over $20 per ton. Often the daily assays from car-samples will run over $40 per ton, and face-samples as high as $80 per ton.

The vein is well-defined, hard, and just as it should be to produce a big orebody, and from its appearance at the present moment the ore is expected to continue for some distance. It must be remembered that this development is proving an orebody of considerably greater value and of somewhat different appearance to anything found on the main vein heretofore, in that it is hard, whereas the main vein has invariably been soft; the gold-contents are considerably higher, and it is anticipated as this vein continues northward it will produce a large tonnage of ore of high grade.

It is intended to sink the shaft 600 ft. during the year 1921, opening up four levels if possible during that time. In order to expedite the opening of additional levels, a winze is being extended below the 3050 level; this will be continued downward, anticipating the various levels when shaft-sinking has reached these various points, as the sinking of the shaft will proceed simultaneously with the sinking of the winze, and for the reason that the orebody is directly east of the shaft, it will be easy to develop because there will be required no long cross-cuts or drifts; therefore, the discovery of this ore-shoot has not only been important to the company, but it has surely been important to the town of Plymouth, which is supported entirely by the operations at this mine, and it also proves the persistence in depth of orebodies on the Mother Lode when geologic conditions are favorable.

No mine on earth could have looked poorer during the first few months of 1920 than the Plymouth Consolidated, and without making an effort to reach the deeper ground in this property it would have closed down and probably have lain idle for a number of years, until somebody with courage came along to re-open the mine on the supposition that prompted the Plymouth Consolidated people to re-open this property in 1911.

The main idea of this article is not for the purpose altogether of eulogizing those connected with the property, or the results obtained for them, but to place on record publicly the results obtained, so that other operators on the Mother Lode may know what has been achieved at the Plymouth Consolidated, thus giving encouragement to those who have encountered poor zones in their mines, and, at the same time, trusting that the encouragement obtained at Plymouth will stimulate other operators to further exertion and deeper sinking.

The Plymouth Consolidated mine has been geologically examined by Oscar H. Hershey, also by F. C. Merritt, both geologists of considerable experience, to say nothing of Malcolm Maclaren, an English geologist of world-wide fame, all of whom pronounce the geologic conditions favorable for the deposition of ore in depth. This advice, together with persistence on the part of the owners, has resulted in the giving of new life to an abandoned mining property.

Canadian Institute of Mining and Metallurgy

The Meeting at Winnipeg

By R. C. Wallace

A year ago there was adopted by the Canadian Institute of Mining and Metallurgy the policy of holding an annual meeting in Western Canada as well as the regular annual meeting in the East. Last November the first Western meeting was held at Vancouver and the second meeting was held at Winnipeg during the last week of October. The papers and discussions were grouped round two central themes, namely, the mining and marketing of Western coal and the extent and development of the metallic resources of northern and eastern Manitoba. As was natural, therefore, Alberta and Manitoba were particularly strongly represented at the convention, but the other provinces of the Dominion, with the exception of the maritime provinces, were also represented by delegates.

Speaking for the province of Manitoba at the opening of the convention in the Fort Garry hotel, the Attorney-General, T. H. Johnson, emphasized the fact that the meeting was being held in a province that had no control over its resources, and invited the members to give serious consideration to the question of the representations now being made by the Province for the control of its mineral and other resources. The same theme was vigorously dealt with by Edward Brown, the Provincial Treasurer, at the closing banquet of the meeting while speaking on 'Provincial Policy and Mining Development'. He stated that no Provincial policy could be inaugurated until the question of the disposal of the resources in the provinces of Manitoba, Saskatchewan, and Alberta was finally settled by the Federal government and that the Province would continue to insist on settlement until such settlement were satisfactorily concluded. With the initiation of large undertakings in the development of the copper industry in the North the representatives of the Province are keenly alive to the necessity of the control of the resources being handed over to the Province before any clear-cut policy of action can be adopted by the Province itself.

In his thoughtful presidential address, O. E. S. Whiteside emphasized particularly the call for service on the part of the Institute and its members individually in the furtherance of the interests of the mining industry in Canada. He suggested various plans whereby the Institute could prove itself a still more valuable ally to the mining industry by educational propaganda in connection with the industry and its national import to Canada. Particularly to business men, who, in the Middle West, look askance at mining investments, the members of the Institute could serve as authoritative sources of information with reference to the mining industry in any area. His words were specially applicable to Winnipeg audiences, to whom mining has meant investment in stocks the value of which they were unable to appreciate and who had not been made aware of other and more important aspects of mining investment.

Among the papers relating to Western coal and its utilization, special reference can only be made to a few outstanding features. F. W. Gray, editor of the 'Canadian Mining Journal', in dealing with the part played by Western coalfields in Canadian development, made a forceful appeal to the coal-consumers of Western Canada to view the situation from its national and international aspects. He pointed out that the possession by Western Canada of 15% of the world's coal will inevitably mean the gradual predominance of Western Canada in Canadian political and industrial life and the maintaining of Canada as a whole free from economic, and therefore political, subservience. First-aid work was dealt with by D. Macdonald, who discussed and demonstrated safety apparatus used in the mines of Alberta. The question of the advisability of having a uniform type of safety apparatus throughout the Provinces was taken up and a committee appointed to collect data and make recommendations. H. A. Mackay described the powdered-coal open-hearth furnaces at the Selkirk rolling-mills, in which Western coal is used, and stated that the only difficulty yet to be solved was the protection of the acid lining, which in present practice was to some extent attacked, presumably by the fused dust from the coal. Some questions in connection with the marketing of Western coal were taken up by D. King, while the resources of Alberta in general were exhaustively treated by J. A. Allen, who made some interesting references to the discovery of oil at Fort Norman in the Mackenzie basin, in connection with the possibilities of the province of Alberta and the Northwest Territories as a last great oil-producer of the continent.

With the exception of a paper on the non-metallic mineral deposits of Manitoba by D. C. McArthur, in which he dealt more particularly with the valuable gypsum deposits of the Gypsumville area, the papers and discussion on the Manitoba field dealt exclusively with the copper and gold areas of the Province. F. J. Alcock, who has recently issued, for the Geological Survey of Canada, a map of the Herb Lake district in which is situated the Rex, Bingo, Northern Manitoba, and other developed or partly developed properties, dealt with the gold deposits of that area from the point of view of their relationship to the country-rock and in particular to the parent granite. The Copper Lake area was discussed by J. P. Gordon

who was responsible for the important discovery of last summer. R. C. Wallace described the Flin Flon orebody, its shape and extent, its relationship to the surrounding country-rock and its origin, and took up some questions connected with the future development of this important copper deposit. The Rice Lake district was fully described by J. S. DeLury, who is engaged in the preparation of a bulletin for the Provincial government on that field. A paper had been prepared by R. J. Colony of Columbia University on the interesting area in the vicinity of Bear river in which the petrological similarity to the Sudbury rock-types was fully investigated. G. R. Bancroft, under whose direction the ore from the Mandy mine has been transported to Trail, discussed the mining and the transportation of that ore and gave interesting details of costs in connection with this unusually difficult method of transportation.

Apart from the trip on the last afternoon of the meeting to the Selkirk rolling-mills and steel foundry, by courtesy of the respective managers, Messrs. Deacon and Davies, who afforded an opportunity to see powdered-coal open-hearth and electric-furnace smelting practice, the iron and steel industry was dealt with in two papers: H. E. Knobel discussed fully the utilization of Ontario iron ores for Canadian furnaces and more particularly the policy of establishing an iron and steel industry at the head of the Great Lakes. F. A. Fahrenwald of Cleveland dealt with alloys and more particularly non-corrosive steels, a subject in which he himself is responsible for important discoveries and advances.

The business sessions were well attended throughout, as were also the more popular evening sessions. At the Smoker, interesting moving pictures were shown of water-power resources and scenes in central British Columbia and on the Pacific Coast by R. C. W. Lett and C. F. Attwood. At the second evening session an illustrated talk was given by R. C. Wallace on the history, settlement, and development of Northern Manitoba, while at the banquet, which concluded the proceedings, the speakers included Edward Brown, the Provincial Treasurer, Mayor Gray of Winnipeg, President Lovatt of the British America Coal Co., J. A. Campbell, and T. R. Deacon. Local business men came most closely in touch with the Institute meeting and with the members at a largely attended luncheon given by the Canadian Club at which the main topics of the meeting and their importance to the business men of the city were especially emphasized.

From time to time the question of the regulations dealing with royalty on Federal lands has been up for discussion before the Manitoba branch of the Institute and the parent body. According to Federal regulations, no royalty is to be imposed on copper and allied metals mined on Federal lands until 1921. After that date the amount of royalty to be imposed will be at the discretion of the Governor-General in Council. It has been foreseen for some time that with the development of an important copper-mining industry in Northern Manitoba, the indefiniteness of the clauses relating to royalty would present a difficulty to investors who proposed to embark on large development projects in northern areas. With the impending development of the Flin Flon orebody this matter has become acute, and a committee was formed at the meeting to discuss the whole question and to formulate a resolution. This resolution, which was passed unanimously, requested that for a further period of ten years, that is, until the beginning of 1931, no royalty be imposed on copper or allied metals produced from Federal lands and that it be now decided on what basis and as far as possible to what degree royalties be imposed after that date. It was felt by the committee and the Institute that the period of time suggested was sufficient to make possible the establishing of a copper industry on a large scale such as at the Flin Flon property and the solving of the metallurgical difficulties therein involved before the State tax became incident, and, moreover, that the declaration of the policy with reference to royalty at an early date would make explicit an item of cost that at the present time is indefinite.

Steam-Electric Project in South Africa

Kimberley and its surrounding mines have long attracted the interest of engineers as a centre for the consumption of cheap power, and the Government Inspector of Machinery for the district in his last annual report says he believes that a scheme is on the tapis to erect a power-station at the Kroonstad colliery, and transmit the electric power generated there through the Orange Free State, by way of Boshof, Koffiefontein, and Jagersfontein, says a recent issue of 'The South African Mining & Engineering Journal'. A line, either direct or branch, will come to Kimberley. Over a year ago a Kroonstad colliery electric-power scheme was suggested, but was then ridiculed by the man who is now doing his utmost to have it carried out. Such a scheme is of first importance to the Kroonstad Colliery Co., whose product, as a steam coal, is of low quality, and therefore cannot hope to compete with the higher-class coal of the country except at points close to the mine. The scheme is capable of expansion, and would, it is thought, be a strong factor, if developed to its full capacity, in liberating much of the latent wealth of this district. There is a plentiful supply of good water available within five miles of the mine, a weir across the Vaal being all that is necessary to ensure the supply of that essential commodity. De Beers Consolidated Mines, Ltd., even on that company's present electric requirements, would consume approximately 8000 kw. New Jagersfontein would require almost as much, as cheap power would be a strong incentive to that company to centralize on a direct-treatment plant to deal with the whole of the ground mined. Koffiefontein Diamond Mine, Blaauwbosch Diamonds, New Eland Diamonds, Roberts Victor Diamonds, all on the route, would, it is thought, require approximately 2000 kw. to satisfy their requirements. An electric railway from Koffiefontein to Fourteen Streams or Vierfontein would be brought within the range of possibility were such a scheme as that under consideration an accomplished fact.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ALASKA

HIGH COSTS AT NOME.

CAPE PRINCE OF WALES. The Lost River Tin Mining Co. has undertaken work on rather a large scale. While the property has been under development for some 17 years, only recently have considerable operations been initiated for the opening of the deposits. The shaft now is down 300 ft. In sinking it was necessary first to penetrate the tundra and afterward the glacial ice, which is some feet thick. The Eskimo laborers are not satisfactory. Those employed in the mine work spasmodically and lately have been becoming more than ever independent because of the high prices to be obtained for the skins of fur-bearing animals. As a fox-skin brings the Eskimo from $35 to $40 and as some of them trap as many as from 75 to 80 in a season it is not hard to understand their disinclination to work as miners.

NOME.—Referring to placer mining in Alaska, Milton B. Roper, of Nome, states that the production has fallen off chiefly owing to the high cost of transportation. Freight is $19 per ton, lighterage $13 per ton, and wharfage $1.50 per ton. Coal in the yard is $46 per ton, which makes gold mining practically prohibitive. Mr. Roper, who is interested in dredging, says that operations of this character are going ahead on a large scale where conditions are suitable. Among the miners and prospectors interest is being manifested in the possibilities of placer mining on the Siberian coast.

JUNEAU, ALASKA, ACROSS GASTINEAU CHANNEL, FROM DOUGLAS ISLAND.

ARIZONA

DEVELOPMENT WORK AT THE IRON CAP PROPERTY. ARIZONA STANDARD IS BUILDING NEW LEACHING-PLANT.

GLOBE.—The Inspiration Copper Co. has posted notices, effective at once, concerning four contests for prizes in first aid work, open to all employees of the company, and to be held on or about the following dates: December 1,

1920, February 1, April 1, and June 1, 1921. In each contest there must be at least three contesting teams of six men each, and the prize will go to the team making the best record, providing that a reasonable standard of skill is reached. The prizes will be in the form of a payment of $5 per month to each member of the winning teams for periods of from twelve to six months. The contests also include the Old Dominion Copper Co. and the International Smelter Co. The shaft at the Iron Cap mine has been sunk to a depth of 1552 ft., with stations cut at the 1400 and 1500-ft. levels. On the 1500-ft. level the Old Dominion vein was found to be 30 ft. wide. The company has not developed the 1400 and 1500-ft. levels yet, as it is the policy to keep ore requirements about two years ahead of mining operations, and that much ore is blocked out already. The concentrator at the Iron Cap is handling about 300 tons per day, the mill not running Sundays.

The International smelter is handling about the same tonnages as in the last few months, its production being dependent on the output of the various mines in the district. New work at the Miami mine is confined to equipping and deepening No. 5 shaft. Mining in the district continues on the same basis as in the past month, and there has been no further curtailment. All operating mines are in good physical condition, and the various managements are following a conservative policy of development and equipment.

KOFA.—The King of Arizona, one of the famous old gold mines of the State, has been taken over by New York interests and re-named the New King of Arizona. During the last few months active development work has been in progress, a good tonnage of ore has been blocked out, and the construction of a mill is being undertaken.

PRESCOTT.—The Philadelphia Mining Co. has taken over the War Eagle Gladiator property at Crown King, on a five-year lease. As the Philadelphia mine is adjacent to this property, it is planned to run a cross-cut tunnel from the Philadelphia into the War Eagle Gladiator vein that will tap the vein at a level several hundred feet below the present deepest workings. The ore contains gold and silver with some copper.

The Arizona Standard Co., whose property is situated about 14 miles north-east of Prescott, is bringing in machinery for a 125 ton leaching-plant and power and other machinery for a 250-ton crushing-plant. T. J. Carrigan, general manager for the company, said that leaching is coming to be recognized as the best method for handling carbonate and oxide ores. There is a large tonnage of such ore on the property, containing from 3% to 7% copper.

BISBEE.—Small hope for improvement next year in the present copper market was expressed by Walter Douglas, president of the Phelps Dodge Corporation, on his arrival here from New York. Mr. Douglas said that the Phelps Dodge Corporation will undertake no expansion or construction work under present conditions, and that it will be compelled to economize at every possible point in order to continue production.

COLORADO

'NEW' PROCESS TO BE TRIED IN LEADVILLE DISTRICT MILL.—SEVERAL LESSEES WILL WORK DURING THE WINTER AT ROSITA.

ASPEN.—The Etcetera mine on Castle creek operated by the Hurricane Leasing Co. is producing high-grade ore from a flat vein opened by an inclined shaft and tunnel. A 20-ton shipment recently was settled for at $175 per ton silver-lead content. The property lies west of the main lime contact.

BRECKENRIDGE.—The Blue Flag Gold Mining Co. is installing new equipment in its Laurium mill. The mill-bins are filled and the plant will commence treatment very shortly. Development continues at the mine and a recent examination by the company's engineer resulted in a favorable report as to ore conditions. Work on the placer holdings has included reinforcement of the dam for protection against spring floods. Many companies and lease-operators are laying in supplies for winter operations.

CRIPPLE CREEK.—The new drill-hole in the east end of the district, driven at a 45° incline, is down about 265 ft. in badly fractured ground. Progress is slow. Interesting developments are looked for in the next 500 ft. as the Blovia phonolite dike-system and spurs should be cross-cut by the drill. Important development is in progress at the Vindicator, in virgin territory south and east of the shaft. Small pockets of rich ore have been found and prospects for the opening up of extensive ore-bodies are considered excellent.

The Granite company and its lessees are producing and shipping a good grade of ore to the Golden Cycle mill from the Dillon, Dead Pine, and Upper Granite properties on Battle mountain. Drifting east toward the Cresson, the Blue Flag Gold Mining Co. is prospecting toward the Cresson with promise of soon entering a richer zone. The vein as now broken is a low-grade mill product. The Blue Flag is equipped with a milling plant not in operation at this time. Owing to poor ventilation during the recent heavy snow storms, work in the 1400 and 1200-ft. levels has been temporarily discontinued and is confined to the 800-ft. level.

LEADVILLE.—A new process, controlled by Joseph T. Terry, for treatment of low-grade and complex ores will be tried at the Leadville District mill. Tests made on ores from the Yak tunnel are reported to have resulted satisfactorily. Mr. Terry has, it is claimed, secured right and title to the mill. Recent shipments of silver-gold ore from the Dinero tunnel, in the Sugar Loaf section, have brought settlement at the rate of 150 oz. silver and 0.31 oz. gold for two cars; two cars settled at 37 oz. silver, 0.21 oz. gold, and one car 55 oz. silver, 0.19 oz. gold. Work continues at the Gertrude at Sugar Loaf, but production and shipments to date have been light.

ROSITA.—Work will be continued during the winter by the Palonia Leasing Co. on the Palonia, Twenty Six M. & M. Co. on the '26', Fowler M. & D. Co. on the Annie, and by lessees on the Leavenworth and Pioneer group.

All are former producers of high-grade silver ore. Among the newer properties now operating are the Stevens, Little Jonny, and Sunset. The Palonia was shipping last week. Work is scheduled to continue during the winter months on the properties named.

SALIDA.—The Ohio smelter at this point has been taken over by Eastern interests represented by Everly M. Davis, of New York, who is also identified with the Rawley mine at Bonanza. A tramway will be constructed connecting the Rawley with the D. & R. G. railway at Shirley about 12 miles from Salida, from which point train service will facilitate the delivery of ore at the smelter. Large reserves of silver-copper-lead ore have been developed, assuring a supply to keep the Ohio smelter in operation for a long period.

MICHIGAN

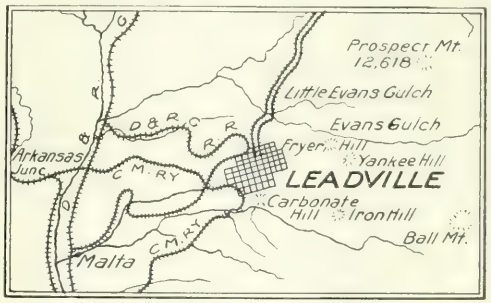
FURTHER WAGE-REDUCTIONS.—WOLVERINE AND MOHAWK INCREASE OUTPUT.

CALUMET.—Following the announcement of the Calumet & Hecla and subsidiary companies of a 15% cut in wages and the closing of the Osceola Consolidated, Osceola branch of the C. & H., White Pine, and La Salle, the management of Mohawk and Wolverine has posted notices of a 15% wage-cut, effective in all departments. The Stanton mines, however, will not reduce their working forces. Instead they will build up their underground department to the pre-war basis. This will absorb some of the several hundred men laid off by the Calumet & Hecla. No announcement of a wage-cut or curtailment has been made by any of the other mines, although it would not be surprising, in view of the stagnant condition of the copper market, if wages were reduced. A reduction of working forces, however, is scarcely looked for by men conversant with the situation. Most of the mines have curtailed as much as possible and further reductions would cause disorganization.

Mohawk and Wolverine are practically the only mines that have no copper at the smelters and prospective business, it is stated, is sufficient to take the output for the next 60 days. If these orders materialize, Mohawk and Wolverine will close the year with no surplus and even on the low market that has prevailed during the past month both mines have at least been 'breaking even'.

The Copper Range mines are carrying about the same surplus as was reported at the end of 1919 and Quincy's shipments have been far below normal. It is estimated that Calumet & Hecla will close the year with 30,000,000 lb. of copper or very close to the surplus reported at the end of last year. Calumet & Hecla has filled most of its current orders and but little business is in sight for the remainder of November, a month in which shipments are ordinarily heavy, for the close of the lake-shipping means that the higher rates for rail-delivery add to the cost of the metal. The company has just shipped 150 tons of ingot bars for export and 350 tons of metal for New England customers, completing its largest orders for the present.

Wolverine and Mohawk 'rock' tonnage has been increasing to such an extent during the past two weeks that the operation of one stamp in the Wolverine mill has become necessary. For the past six months, the combined production of the two properties has been stamped in the Mohawk mill, with one head allotted to Wolverine 'rock'. With the improvement in the labor situation, an increase of about 15% in output has resulted and Mohawk 'rock' now will require slightly more than three heads. Both mines now are operating at about 80% of normal and unless unforeseen events occur, it will be possible to return to normal before the first of the year. Normal production for Mohawk is about 2400 tons of rock daily and for Wolverine, 1200 tons. Mohawk has been down as low as 1800 and Wolverine to 600 tons during the slump in the metal market. It now is the intention to take on more underground men until production is back on the pre-war basis. As soon as the men are taken on and the output warrants it, a second head



LEADVILLE, COLORADO, AND VICINITY

in the Wolverine mill will be started. It is likely that many of the men let out by the Calumet & Hecla will find places at Wolverine or Mohawk.

Wolverine has started the use of a level-scraper in one of its shafts and it is measuring up to the fullest expectations. In fact it is operating so satisfactorily that it is planned to build others. As soon as the underground force is built up to normal, it is the intention to explore several veins, other than the Kearsarge, running through the property. Lodes on the 13th level, west, and the 28th, east, will be opened by drifting. The first is the Kearsarge conglomerate, which revealed traces of copper in a cross-cut. There is no assurance that the vein will be found to have commercial value, but the appearance of it at a point of contact warrants exploration, and the only manner in which the vein can be thoroughly tested is by drifting. On the 28th level two or three lodes were penetrated by a cross-cut. Ten or fifteen feet of drifts were put in each one and one of the veins is believed to have possibilities. The introduction of mechanical scrapers may be a factor in the development of new lodes on Wolverine lands, for it will result in a material reduction in costs and make it possible to mine leaner lodes profitably. There is little hope that either Mohawk or Wolverine ever will be able to use an automatic shovel of large dimensions, for the lode is too flat. Accordingly,

Wolverine at least will confine its efforts to the further perfection of the scrapers only.

Mayflower-Old Colony has completed its west cross-cut, driven from the south drift. It has penetrated the foot-wall trap and a cross-cut now has been started to the east, with the hanging wall as the objective. At a distance of 13 ft. from the drift, the showing is described as very good. The south drift is proceeding intermittently and at a distance of 310 ft. from the shaft exceptionally encouraging mineralization has been disclosed. The raise being put through the conglomerate lode in the cross-cut east from the north drift is still in the formation at a height of 15 ft. The showing thus far on the 1700-ft. level is better in the south drift than elsewhere. If it is finally determined that the ground south of the shaft is commercial, Mayflower will have a long stretch or territory to mine, for the property limits are about a mile south of the shaft and the western boundary is nearly a mile distant.

A test of Gratiot rock is about to be made by the Seneca Mining Co. An initial shipment of 533 tons has been sent to the Baltic mill of the Copper Range Consolidated, where Seneca rock is occasionally stamped. The result of the test will be awaited with considerable interest. Seneca makes a shipment of a few cars now and then during the course of development work and the rock is said to be yielding a satisfactory return.

NEVADA

THE DEVELOPMENT COMPANY RETURNS MILL TO CONSOLIDATED.

EUREKA.—Work in the Locan shaft, on Ruby hill, has been suspended for more than a week, owing to the breaking of one of the cylinders of the big air-compressor. It has been replaced with a new one. At the Eureka-Holly mine ore is being stoped, while the shaft is being sunk deeper. High-grade ore is being shipped to the smelter. The excavation for the new mill has been started 120 ft. north from the main shaft, and the machinery has nearly all been delivered. Four cars of fuel-oil for the semi-Deisel engine at the hoisting-plant have likewise arrived. H. R. Layng, of San Francisco, has arrived in Eureka and has taken charge of the building of the mill at the Holly mine. The ore will be treated by a volatilization method. The company's teams have been hauling ore from the Eureka-Croesus mine to the Eureka-Nevada railroad during the week and will probably continue as long as the weather will permit. The management reports good shipping-ore in the No. 7 and 8 winzes and in the raise on the shale and also good results from prospecting in the adjacent limestone. In the Uncle Sam mine, work is progressing satisfactorily along the main fissure, except that the night shift has been suspended because of bad air. This will be remedied by the installation of air-pipes and the night shift will go on again as usual. The fissure has one wall heavily stained with iron oxide, and at one point on the surface shows some ore, raking toward the face of the drift.

GOLDFIELD.—The Goldfield Development Co. has turned back to the Goldfield Consolidated Mines Co. the Consolidated mill, which had been held under lease for more than a year, and it is reported that the Development has abandoned all of the big plans for mining and milling that were announced in March 1919 by A. I. D'Arcy, general manager. It appears to be the general opinion in well-informed mining circles on the coast that the Development enterprise has failed and it is said that only enough of the 1000-ton mill will be left standing for possible treatment of the tailing by the Consolidated. The Development has had a short and checkered career, during which it has passed from the heights of promised success to the depth of generally recognized failure. On February 1, 1919, H. G. McMahon, as trustee for a corporation then being organized and later known as the Goldfield Development Co., acquired the properties in Goldfield of the Consolidated, with the exception of the mill, which was taken over later. The company for a short time gave the mines over to sub-lessees and early in March the plans for 'glory-holing' the Combination were announced. The block to be mined was said to be 1000 ft. long, 40 ft. wide, and to extend to the 380-ft. level. The average value of the ore, practically all stope-filling, was estimated at $5.60 per ton. Later in March an estimate of 1,500,000 tons of ore in this block was made. The cost of putting the mine and mill in condition was given as $75,000 and the profit to be derived from the 1,500,000 tons of ore was placed at $3,000,000. The sale of stock was then commenced, a special appeal being made to shareholders in the Consolidated. In June it was reported that L. E. Whicher, of New York, had formed a syndicate and had taken a large interest in the company, which was said to have $100,000 in the treasury. Many publications, quoting officials of the company, gave optimistic news, and the mill was to have been started on July 1. On June 13 it was announced that Whicher had bought the Florence and had leased the Reilly block to the Development, the officials of which said the block contained 500,000 tons of ore that could be milled with that in the Combination, according to reports published at that time. About this time two blasts were fired in the Red Top in ore that was said to be 300 ft. long, 60 ft. wide, and 165 ft. thick. The average value of 3000 tons said to have been broken in the first blast was made public as $22.40 and the second was reported to have broken 6000 tons of $23.80 ore. On August 15 the first ore for the mill was to have left the Laguna shaft. It was in August that D'Arcy, after issuing the report that has since been made the subject of much controversy, resigned as consulting engineer for the Tonopah Divide to give all of his time to the management of the Development. The first apparent difficulty came in September, when the working force was cut during the Tonopah-Divide strike because of "poor financial conditions". This, coming at a time when the company was thought by the public to be well financed, caused wonder, which was entirely relieved when D'Arcy, after a trip to New York with McMahon, announced in November that they had arranged for re-

financing the company. The details of the plan by which the company was to be re-financed were never announced, but it became generally known in the East and on the Pacific Coast that about this time Whicher severed whatever connection he may have had or had planned to have with McMahon and D'Arcy. This he is understood to have done on advice of his engineer, F. Sommer Schmidt. D'Arcy said in a detailed report issued at this time: "Work on mill repair and construction has already commenced. It is 85% complete at the present time for a tonnage output of 650 tons daily. Completion of the other 15% requires only 30 days. Naturally enough, we shall lose no time in reaching a 2000-ton daily output after the mill begins to operate." The "development and construction" expense to October 28, 1919, was given as $100,000. The cost of increasing the capacity of the mill from 1000 to 2000 tons was estimated at $205,000. "The management has found it necessary to re-finance the company and it will be able to report to stockholders within a few days that it has arranged the necessary new financing which will permit the carrying out of the full program as outlined." D'Arcy was quoted early in February as saying the mill would start treating 500 tons daily on April 1, but before that date a 3c. assessment was levied because of "adverse financial conditions". A financial statement issued with the notice of assessment, which was delinquent on April 3, gave as $127,000 the cost of construction, equipment, and mining. Finally the mill was started on June 16 of this year and, after it had operated for less than two months, assessment No. 2 was levied "for the purpose of creating a surplus to meet operating costs up to September 15, at which time returns should well exceed expenses and the operation show a tangible profit". A statement issued with the notice of assessment said that to July 30 there had been delivered to the mill 4800 tons of ore of a gross value of $9.50 per ton. The net profit was given as $12,000, but "the major portion of the values now in solution will not be produced in the form of bullion until the final clean-up". Continuing, the statement said: "Promising mine developments continue and I trust that the shareholders approve of our policy of starting milling operations on this small but profitable scale, gradually working up to the fulfilment of our original plans of a large tonnage daily of lower grade ore." This was the last report made by the company. The Deep Mines has suspended operations following labor trouble, but it is said work will be resumed in the spring. Nothing has been heard recently from the Yellow Tiger, which suspended operations shortly after levying an assessment. The present status of the operations may be the end of an interesting chapter of Nevada mining. The Development company, after riding on the crest of good reports, now apparently has passed away without even a eulogy.

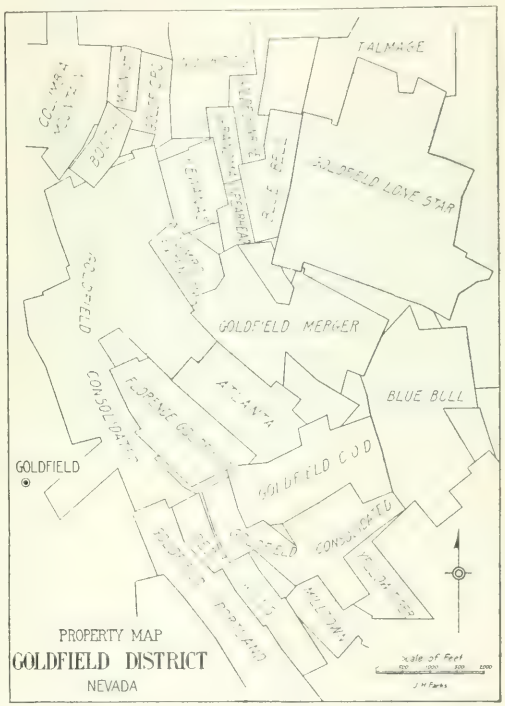
Pioche.—The Black Metals Mining Co. has opened a body of high-grade carbonate on the 300-ft. level of the Day mine. Grab-samples of the ore show 30 oz. silver and 15.7% lead. Ore shipments from this district for the week ending November 13 totaled 2760 tons.

UTAH

UTAH COPPER CO.'S REPORT FOR THIRD QUARTER. NEW ORE FOUND IN EUREKA HILL MINE.

Salt Lake City.—At a meeting of the Utah section of the American Institute of Electrical Engineers on November 16, L. B. Fuller and J. B. Ambler were appointed to draft the proposed State license law for all engineers engaged in public work. The proposed law will be presented to the State Legislature, when it convenes in January, for consideration.

Articles of incorporation have been filed with the



Secretary of State by the Minerals Salt Corporation, the capitalization of which is $500,000, divided into 5000 shares of a par value of $100 each. The company owns deposits of sodium sulphate on the south shore of the Great Salt Lake, and a preliminary plant is now being constructed. The products of the plant will be Glaubers salt and salt-cake. The officers of the new company are: R. F. Geoghegan, president; R. H. Jones, vice-president; Lawrence Clayton, secretary; N. W. Clayton, treasurer; E. L. Sheets, A. C. Danie, and Oscar W. Moyle, additional directors.

The Utah Copper Co. has released its fiftieth quarterly report, covering the third quarter of 1920. During that period there was treated at the Arthur plant 1,497,900 dry tons, an increase of 69,300 tons as compared with the second quarter. The ore averaged 1.079% copper and the extraction was 76.57%, as compared with 1.213% copper and 82.8%, respectively, for the preceding quar-

ter. The decrease in heading was due to the large quantity of low-grade ore shipped from the upper steam-shovel levels. The total production of copper for the quarter was 25,331,217 lb., as compared with 29,004,381 lb. for the second quarter. The average cost per pound of net copper produced was 17.156c., as compared with 13.697c. for the second quarter; these costs being exclusive of credits for gold, silver, and miscellaneous income. The value of the gold and silver was $178,683, and the miscellaneous income amounted to $153,332. These items combined are equal to 1.377c. per pound of copper produced. The net profit for the quarter was $502,953, and after the payment of a dividend on September 30, the deficit was $1,933,781, as compared with a deficit of $196,265 for the second quarter. The earnings are computed on a basis of 15.791c. for copper; this low carrying price being due to the small sales during the quarter and the increase in copper on hand carried at 13.5c. per pound.

ALTA.—Operations on the Little Cottonwood Transportation Co.'s railroad were suspended on November 15, according to Shand Smith, manager. The railroad runs from Wasatch to Alta. The last three miles of the track to the mines is covered with four or five feet of snow, and the expense of keeping the line open was not justified. During the season, approximately 7000 tons of ore was shipped over the road, practically all of which came from the South Hecla, Michigan-Utah, Emma Silver, Columbus-Rexall, and Sells properties. Owing to weather conditions, the Columbus-Rexall property was able to haul ore only 14 days during October, and none at all during November. The mine force has been kept busy on exploratory work in the meantime. M. R. Evans, general manager for the company, states that ore awaiting shipment at the mine averaged 52 oz. silver, 21% lead, and 4.4% copper, or a net value of about $70 per ton. Mr. Evans reports that the mine is in excellent physical condition, and that there are a half dozen stopes from which ore of commercial grade can be extracted.

PARK CITY.—At the old Daly mine, now under the control of the Judge Mining & Smelting Co., Oscar Friendly, superintendent, is now mapping out a system of development to explore virgin territory. A clean-up shipment, consisting of 50 tons of spelter, was made by the Judge smelter, after which the employees were transferred to other work. It is reported that the smelter will resume operations in the spring. Shipments from this district for the week ending November 13 totaled 1818 tons, of which the Silver King Coalition shipped 584; Ontario, 519; Judge properties, 500; Keystone, 165; Judge smelter, 50 tons of premium spelter.

Recently a seam of high-grade ore was uncovered in a new portion of the workings at the Park-Utah property, which has been opened to a width of about 30 in. This makes four shoots of ore at this property, ranging in width from one to four feet, all averaging better than 50 oz. silver. The company has an efficient crew of workmen, and will continue development during the winter. At the Ontario property, the new orebody discovered on the 1700-ft. level has been opened for a length of 80 ft. The ore is understood to be of high grade.

EUREKA.—Recently a new orebody was opened by lessees in the Eureka Hill mine after considerable development work had been done through the workings of the Centennial-Eureka company, which adjoins the Eureka Hill. Four cars of silver-lead ore have been shipped, averaging about $40 per ton. This ore was found on the 900-ft. level, in close proximity to the New Year channel, which was a heavy producer of high-grade ore in the early days. In the Gemini mine, also adjoining the Eureka Hill, an orebody is being developed at a point 40 ft. below the 900-ft. level, close to the boundary line between the two properties.

During the week ending November 13, the Tintic Standard shipped 46 cars of ore; Chief Consolidated, 37; Dragon, 16; Eagle & Blue Bell, 13; Iron Blossom, 6; Iron King, 5; Victoria, 4; Grand Central, 4; Gemini, 3; Swansea, 3; Centennial-Eureka, 3; Bullion Beck, 1; Ridge & Valley, 1; Tintic Mill, 1 car of bullion, making a total of 145 cars.

For some months past, work has been under way in the east drift on the 900-ft. level at the Apex Standard Mining Co., and the face is now in dolomitic lime. The drift is now about 400 ft. from the shaft, and previous to taking up this work, a drift was sent toward the north, where several bunches of ore were cut. An effort was made to drive a raise from the north drift, but after it had reached a point 40 ft. above the level, work was stopped, owing to the excessive heat.

BRITISH COLUMBIA

INFLUX OF MINERS TO THE SLOCAN AND WINDERMERE DISTRICTS.

STEWART.—H. A. Guess, of the American Smelting & Refining Co., is quoted as saying that the development of the Premier property has disclosed actual ore, and the possibility of a greater tonnage than has yet been proved. Development meets optimistic expectations. He refers to the plans being made to ship over the snow during the winter and stated that the muddy condition of the road during the summer made the transport of ore to the Coast impracticable. Two caterpillar tractors and sleds will be provided as soon as the trail hardens. The water-power plant at the Premier will be in operation in less than a month, permitting the utilization of larger compressors and more rapid progress in the development and exploratory work now under way. The cyanide mill will be completed and in operation early next year.

WINDERMERE.—There has been a considerable revival of mining in this district. E. J. Fader has completed a 600-ft. tramway, connecting the new ore-bunkers with the working tunnel at the Bunyan mine. New bunkhouses that will accommodate 150 men are in course of erection, but, owing to the difficulty of getting supplies during the winter these will not be finished until spring. The ore is taken by 6-ton auto-trucks from the bunkers to the railway at Windermere. About 30 men are em-

ployed at the mine, which is all that can be accommodated at the present time. Australian interests are opening the Isaac mine, at Brisco, and are re-opening the Nip-and-Tuck. From the latter property a considerable amount of ore has been taken, and is being packed to the road for shipment to Trail. The ore is said to assay $50 per ton. Thomas Masterman is in charge of both properties. The Paradise, at Athalmer, which is the 'stand-by' of the district, has been shipping steadily to Trail for some time past.

MOYIE.—A rich ore-shoot has been opened at the Society Girl mine, and ore is being mined for shipment to the smelter. This property was re-opened only last August, after a prolonged period of idleness. Work will be continued through the winter.

NELSON.—The strike instigated by the One Big Union in the Slocan district last spring has been definitely broken by a flood of unskilled labor pouring into the district from the Canadian prairies. The Noble Five mine, which has been scratching along with between 20 and 30 men now has a full crew of 70 men. Fortunately the company has recently completed its new bunk-house, which, incidentally, is by far the best of its kind in the interior. It is electrically lighted, steam-heated, and contains shower-baths supplied with hot and cold water and an excellent reading-room, so now the company is able to house the new men in a way that is likely to keep them contented. The Rambler-Cariboo, McAllister, Roseberry-Surprise, and Bosun all have full crews, so during the remaining six weeks of the year the Slocan is likely to give a good account of itself. The output of the district this year will be only one-third of what it has been during the last few years. It is unfortunate for the mine-owners of the district that they have not been able to take advantage of the high metal prices, especially that of silver, that has ruled of late. The Associated Boards of Trade of Eastern British Columbia has wired to the Canadian premier to ask the reason for the recent advance in coal and coke prices, and has requested a suspension of the Coal Commissioner's order pending an inquiry. It is stated that the increase in the price of fuels has caused an increase of 50c. per ton in the ore-smelting charge at Trail.

TRAIL.—The feature of recent operations at the smelter has been the increase in the production of the Consolidated M. & S. Co. mines. Out of a total amount of 11,149 tons, received during the first week in November, the company's mines contributed 10,350 tons. The other shippers were: Florence, Princess Creek, 104 tons; Horn Silver, Similkameen, 48; Iron Mask, Kamloops, 46; Josie, Rossland, 286; Knob Hill, Republic, 41; tons; North Star, Kimberley, 173; Sally, Beaverdell, 40; and White Bear, Rossland, 61.

FAIRVIEW.—High-grade ore has been found at the Submarine Extension. The Submarine mine, formerly the Lone Pine mine, is just south of the international boundary. The lode strikes north-east and south-west, and the new discovery has been made on the British Columbia side of the international boundary. Although details of the new find are not yet to hand, it is said to be the most important discovery that has been made in the district for a long time.

BARKERVILLE.—Representatives of New York capitalists have made an examination of the ground around Williams creek, with a view to testing its dredging possibilities. A thorough test of the ground is to be made by drilling, and if this should give as promising results as surficial tests indicate, a dredge is to be put on the creek next year. Thomas Blair, brother of the well-known merchant, has been prospecting quartz lodes at Proserpine mountain; a recent assay of ore taken from the bottom of a 17-ft. shaft gave a return of $17 per ton in gold and silver. It is generally believed here that if a branch line were built to connect with the Pacific Great Eastern at Quesnel, a distance of only 60 miles, there would be a revival of alluvial-gold mining in this district, as it is generally conceded that there is a considerable amount of ground that could be worked profitably with a dredge, and the branch railroad would enable heavy machinery to be brought in easily.

WAREHOUSE AT VICTORIA MINE, SAN LUIS POTOSI

VANCOUVER.—A matter of scientific, rather than commercial, interest has been the discovery of an 18-in. seam of coal in the heart of the city. While driving a tunnel underneath one of the main traffic arteries the seam was cut, and some workmen have filled sacks and taken the coal home. It is said to burn brightly and give a good heat.

ONTARIO

REPORT OF KIRKLAND LAKE DEVELOPMENTS.—GOVERNMENT TO TEACH PROSPECTORS.

PORCUPINE.—The Dome Mines Co. has increased its working forces by the arrival of 109 Cornish miners brought from England under a four-months contract, which has enabled the company considerably to increase the scope of its underground operations.

Owing to the order-in-council of the Provincial government declaring mining claims on which the tax of five cents per acre had not been paid to be forfeited, a number of claim holders have lost their properties. The most

valuable of these was known as the Little Pet, situated within half a mile of the Dome, on which $100,000 had been spent in development and the installation of a small mill, which was thrown open and re-staked. It is stated that the owners were unaware of the tax. The action of the Government is strongly condemned in mining circles as likely to discourage investments.

KIRKLAND LAKE.—A special report by Frank L. Culver, president of the Kirkland Lake mine, states that cross-cutting for 110 ft. on the 900-ft. level has picked up an ore-zone 35 ft. in width. Drifting in this zone, on the hanging-wall side, they found ore with assay-gold content in sulphides, running from $15 to $42, and in drifting on the foot-wall side free-gold ore, special assays of which yielded $37 and $122. Channel assays for 5 ft. across the face of the drift averaged $52. Ore from this level is now being treated at the mill. The finding of this ore on the 900-ft. level proves the orebody to persist from the 200-ft. level downward for 700 feet.

WEST SHINING TREE.—The management of the Atlas has decided to install a four-drill compressor and undertake development on a more comprehensive scale, including the sinking of the main shaft several hundred feet. The proved mineralized zone has been considerably extended since spring.

COBALT.—By curtailing certain branches of work, the supply of power in the Cobalt district is believed to be adequate to assure operation of the mines throughout the winter. At the time of writing, only one producing mine, the Beaver Consolidated, has closed down. This was due in part to a break in the crusher that, combined with power-shortage, led to a decision to curtail work until repairs are made and to resume at such time as power-supply becomes more satisfactory. The National Mining Corporation (1920), Ltd., has purchased an interest in the White Reserve mine at Maple Mountain in the Elk Lake district. J. B. Tyrrell is consulting engineer in Canada for this corporation, which was incorporated less than two years ago with £2,500,000 paid-up capital. The White Reserve is the first venture of the new company in Northern Ontario. The property will be explored by core-drilling.

During October the Nipissing mine produced $184,578. This compares with $225,100 in September, the reduction being attributed to 'power interruptions'. An average of 30 tons of ore is being shipped daily from the Peterson Lake mine. The revenue from this, as well as the retreatment of tailing, is said to be adequate to finance a scheme of underground exploration and development in the company's undeveloped areas. H. Mills, Minister of Mines, announces the intention of the Department to start prospectors' classes at strategic points in Northern Ontario. W. L. Goodwin of Queen's University will be in charge of the work. Instructors will be placed at each point selected, competent to give an outline course in geology. At the mining schools of Haileybury and Sudbury a beginning will be made early in the new year, and the course will consist of instructions over a period of about two weeks. In centres where high-schools or collegiate institutes are situated and laboratories are available, blow-pipe instructions will be included. A minimum attendance of ten persons will be necessary in order to justify the holding of a class.

Owing to the Mining Corporation of Canada being involved in the development of the Flin-Flon property in Northern Manitoba, mining interests in Northern Ontario have endeavored to obtain an official statement as to progress. Mr. Ayer, one of the Flin-Flon operators, has made this statement: "We can say that the results obtained from development to date are fully up to our expectations. Considering this fact, the statement of our engineers that the diamond-drilling, on which the original ore-estimate was made, has been very carefully done, lead us to believe that the grade and tonnage of ore on the property will be as high as anticipated."

MEXICO

IMPROVEMENT IN MINING CONDITIONS.

MONTERREY.—Not only have mining operations in Mexico been stimulated by the restoration of peace throughout the country, but the changed attitude of the Government toward the industry is encouraging to the owners of various properties, it is stated here. Several objectionable and oppressive provisions were contained in the decree relating to the operation of mines which was issued by the Carranza government on June 27 of the present year. These provisions, which especially affected foreign mining investments, have been repealed by the De la Huerta government. Americans and other foreigners can now file on mining claims and procure titles to them without jeapordizing their nationality. Another important ruling issued by the new Government is to the effect that taxes on mines that may be delinquent may be paid in installments instead of all at one time. The Government has also recognized as valid tax payments which mine-owners may have paid to different revolutionary factions. In many instances taxes were paid to two or three different political factions in the course of a year. Where this was done the Government has given credit for all such taxes paid. It is expected that comparatively few titles to mines will be declared forfeited for non-payment of taxes during the long revolutionary period. Many American mine-owners have returned recently to their properties after an enforced absence of several years.

While the strike of coal miners in the State of Coahuila is having a serious effect upon the operation of smelters and reduction plants the Government is making every effort to relieve the situation. It has taken over several of the coal mines where striking operatives had prevented the owners from getting out coal, and is shipping considerable quantities of fuel to smelters and other industrial plants. The large smelter of the American Smelting & Refining Co. at Velardena, State of Durango, which was closed during much of the time the different revolutionary and banditry forces were in control of that part of the country, is now running full blast, and has on hand a supply of coke to run it for some time to come.

HOOVER BECOMES PRESIDENT OF FEDERATED ENGINEERING SOCIETIES

The American Engineering Council of the Federated American Engineering Societies was organized at a meeting held in Washington on November 18. Measures will be taken to promote the establishment of a Department of Public Works, creation of a Federal budget system, solution of the transportation problem, and conservation of the country's resources. Washington was tentatively selected as headquarters of the Council which will represent more than thirty engineering societies with a combined membership of more than 100,000. Herbert Hoover, president of the American Institute of Mining Engineers, was elected president. He addressed the convention on the following evening. He said that intermittent employment, unemployment that arises in shifting industrial currents, and strikes and lock-outs were three sources of waste in production.

Intermittent employment might be eliminated at least in part by co-ordination of economic groups, the various industries working together to aid each other. Using the bituminous coal industry as an example, he said the bad economic functioning could be remedied through a concerted effort of the coal-operators, the coal-miners, the railways, and the great consumers to prevent alternate oversupply and shortage.

Present necessary legislation against combinations, he added, makes co-ordination impossible, but he suggested that there be developed "some method of governmental interest, not in governmental ownership, but in stimulation to co-operation in better organization".

Loss of production incident to shifting of workers because of seasonal and short period operations in industry Mr. Hoover said, could be lessened by the expansion and better organization of local and Federal labor-exchanges. Unless such machinery is provided, the individual worker, he said, "is helpless to find the contacts necessary to make this shift".

Strikes and lock-outs would be materially lessened by the universal acceptance and use of collective bargaining, Mr. Hoover declared, adding that he was confident that this principle could be worked out along the lines laid down by the President's second industrial conference, of which he was a member.

ARIZONA

Oatman.—It is reported that a two-foot vein of very rich gold ore has been found on the 600-ft. level of the United American mine. The vein is presumed to be a continuation of that in the Ben Harrison claim of the Tom Reed company, despite the fact that the Big Jim fault was thought to have displaced the vein. The Tom Reed owners could have purchased the United American property for $2500 some years ago. The high-grade ore has been followed for 10 ft. with no diminution in richness.

CALIFORNIA

Amador County.—Thirty stamps are dropping regularly at the Central Eureka mill and some of the richest ore extracted from the property is being mined on the 3900-ft. level. Mine operations are rapidly approaching normal, following the withdrawal of power restrictions and an improved labor situation. Prospecting in the upper levels has been resumed.

Calaveras County.—The construction of a new ten-stamp unit at the mill of the Carson Hill Gold Mining Co. has been practically completed and the battery will start in about two weeks. The addition will increase the capacity of the mill to approximately 15,000 tons per month. In October the mill treated 10,500 tons of ore, and operations for the month are said to have netted the company about $65,000. The ore sent to the plant is averaging more than $11 per ton, with total operating costs approximating $5 per ton.——At the Morgan mine development has been carried to a depth of 1750 ft. with new reserves of ore exposed. The deeper work is proving satisfactory. In addition to the large bodies of milling ore, considerable high-grade quartz ore is reported to be in sight.

IDAHO

Coeur d'Alene.—Miners are more plentiful and many of the smaller properties are doing assessment work. The Alma Mining Co. reports that the company intends to resume development. The Jumbo Mining Co. is working on its property in the Murray district and may continue this work in the spring. The Square Deal mine is doing assessment work and has an 800-ft. tunnel. The Tucker Mining Co. has a small force extending the main drift on its property near Mullan. Ten men, working two shifts, are driving a cross-cut in the property of the Brady Development Co. on Nine Mile. They expect to reach the vein in the next 30 feet. The assessment work on the Big Elk, in the St. Joe district, last summer uncovered a big vein of iron-oxide ore containing some silver.

Lessees on the Western Union mine have opened an excellent body of ore. One car that returned $4000 has been shipped and another is ready. There is no zinc in the ore, which assays 60% lead and 52 oz. silver. While the vein from which the lessees are mining is a rich one, the management of the company does not think it is the main vein and is said to be planning diamond-drill work to cut the main vein at a point 200 ft. north.——Shipments of the Consolidated Interstate-Callahan Mining Co. in October were greater than those of September by about 20%. The figures are as follows: Zinc concentrate, 5,000,000 lb. in October as compared with 4,230,000 in September; lead concentrate, 2,600,000 lb. as compared with 2,180,000, and silver, 26,000 oz. as compared with 21,800 in September.——The Progress Gold Mining Co. in the Murray district of the Coeur d'Alene will continue hand-drilling this winter and in the spring hopes to put in a compressor. A lower tunnel has been started to cut the vein at a distance of 400 ft. At this point on the surface the vein is 8 to 10 ft. wide, with gold content ranging from $9 to $76 per ton. The average is more than $30 per ton. The ore also carries silver and copper.——F. W. Bradley, president of the Bunker Hill & Sullivan Mining & Concentrating Co., after spending considerable time at the smelter and mines at Kellogg, Idaho, says:

"The efficiency of the property is being increased all the time. The smelter has settled down to steady business. The

only addition that will be made is probably a Cottrell treater. This will be used to protect the properties about us and to make greater recovery of lead and silver. Otherwise the plant is as efficient as any plant. We are pushing right along in our experimental work on zinc and are making decided progress, which, we hope, will result, within a reasonable time, in the installation of a zinc-plant annex to our smelter. This is all the more necessary for our district now because other smelters are beginning to refuse to take any zinc ore at all under the present market conditions. The bottom level of the mine is the best we have opened. This level is 1200 ft. below the Kellogg tunnel and 3400 ft. from the surface."——The suit of the Federal Mining & Smelting Co. against the Hecla Mining Co. for $6,000,000 has been settled, according to Frederick Burbidge, general manager for the Federal company. Mr. Burbidge states that an effort will be made to settle such claims as the Marsh Mines Consolidated may have. The Marsh is the lessee of the ground containing the vein on which an apex claim was made and is an intervenor in the $6,000,000 suit. The Hecla company is to pay $450,000 for title to the Russell and Mono fraction claims and a release of all claims for trespass and wrongful extraction of ore.

MONTANA

Deer Lodge.—The new plant of the Champion Mining Co. is nearing completion; it is a 150-ton stamp-mill. Silver is the chief metal, samples having assayed in excess of 100 oz. per ton.

Basin.—The Obelisk Mining Co. recently opened a rich silver vein at its property. The vein has a width of more than six feet and assays 44 oz. silver and 3% lead. It is the intention of the company to install new machinery and work the property on a larger scale than at present.

Butte.—During the month of October the Anaconda company produced 11,000,000 lb. of copper, 100,000 lb. less than in September. The Butte & Superior Mining Co. has suspended operations on account of the unsatisfactory metal market. Some development work in the lower levels of the mine is being done, however, and the organization, except for miners, will be kept intact.

UTAH

Salt Lake City.—A conference of those in charge of the Western offices of the Division of Mineral Resources of the U. S. Geological Survey was held here from November 3 to 8, inclusive. Those present were the geologists in charge of the divisions; G. F. Loughlin, of Washington; Charles G. Yale, of San Francisco; Charles W. Henderson, of Denver; and Victor C. Heikes and C. N. Gerry, of Salt Lake City. James M. Hill, the geologist now attached to the San Francisco office, was also in attendance. The discussions covered the preparation of reports, revision of Western Office blanks, and classification of ores, etc. Questions concerning the proper classification of ores, simple and complex, occupied much of the time, the object being to decide on uniform percentages, fixing certain ores in certain classes, the same practice to be followed in all the offices of the Survey. This will result in more uniform tabular statistics relating to ores in all the States, the questions in doubt having been settled at the conference. The party visited the Utah copper mine at Bingham Canyon and other points of interest in the vicinity.

WASHINGTON

Chelan County.—The Royal Development Co. has begun work on its mining claims on Red mountain, 25 miles north of Leavenworth. Plans of the company are reported to include the building of a railroad from the Great Northern to the property and the construction of a smelter and power-plant.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

H. Hardy Smith is in London.

Ernest G. Ashby, auditor for the Algunican Development Co., is here from Montreal.

H. G. Nichols is with the Canada Copper Corporation, at Copper Mountain, British Columbia.

George W. Nicolson has resigned as general superintendent of the United Verde Extension mine.

A. G. Cadogan, who has been in a hospital in San Francisco for a month, has recovered and has returned to Cuba.

A. J. Burritt, geologist of Salt Lake City, has been making an examination in the Uintah Basin district in eastern Utah.

Lyman F. Barber has charge of the construction of the milling plant for the C. O. D. Mining Co., at Kingman, Arizona.

W. A. Barnes, general manager for the Eureka-Holly and Bullwhacker mining companies, is at Eureka, Nevada, from San Francisco.

Charles P. Richardson with **F. Rolandi,** the contractor, is constructing a two-mile tunnel from Hat creek to Pit river at Fall River Mills, Shasta county.

H. S. Mulliken, of Lexington, Massachusetts, has been appointed metallurgical engineer for the Bureau of Mines, and will act as assistant to **F. G. Cottrell.**

Charles W. Henderson, in charge of the Denver office of the U. S. Geological Survey, is visiting the San Francisco office, where he was formerly employed, on his way to his family home in Oregon, while on his annual vacation.

Obituary

Curtis H. Lindley, accounted one of America's foremost authorities on mining law, died on November 20 at his home in San Francisco. He was stricken ill at the conclusion of the trial of an important mining case in Arizona and had returned only two days before. During the War he attained international prominence as the legal adviser of Herbert Hoover; he was an active member of the board of directors of the Panama-Pacific International Exposition. Born in Marysville in 1850, his early life was spent in the mining communities of California and as a boy he developed an interest in mines and miners that was later reflected in his legal practice. His book, 'Mines and Mining', is regarded as the best legal authority on those subjects and has given him prominence throughout the mining world. He was educated at the College of Santa Clara and the University of California, later studying abroad and winning degrees from several universities. He was admitted to the bar in May 1872. A month later he married Lizzie Mendenhall of Santa Clara, who, with one son, Curtis Lindley Jr., and one daughter, Mrs. Vernon S. Rood, survives him. He was appointed secretary of the California Code Commission in the same year. In 1883 he was city attorney of Stockton, and a year later became superior judge of Amador county. After leaving the bench he began the practice of law in San Francisco, where he was associated with Henry Eickhoff. Throughout his career he has frequently been given places of honor by the legal profession. In 1909 he was made president of the State Bar Association. During recent years he has appeared as counsel in mining litigation in many States of the West. He held honorary professorships in the departments of jurisprudence at the University of California and Stanford University and membership in numerous scientific societies.

THE METAL MARKET

METAL PRICES

San Francisco, November 23

Aluminum dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	16.50—17.00
Lead, pig, cents per pound	6.25—7.25
Platinum, pure, per ounce	$85
Platinum 10% iridium per ounce	$125
Quicksilver, per flask of 75 lb.	$80
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

November 22.—Copper is inactive and weak. Lead is quiet and easy. Zinc is dull and lower.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Date	Average week ending Cents	Pence
Nov. 16	76.62	51.00	Oct. 11	86.77	55.66
" 17	78.75	51.37	" 18	83.10	54.05
" 18	78.00	50.75	" 25	79.52	52.31
" 19	76.12	49.87	Nov. 1	80.31	52.35
" 20	75.00	49.00	" 8	81.90	54.00
" 21 Sunday			" 15	80.02	53.50
" 22	74.00	47.75	" 22	76.41	49.96

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	93.66
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	83.48
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Nov. 16	14.75	Oct. 11	17.85
" 17	14.75	" 18	17.15
" 18	14.75	" 25	15.75
" 19	14.50	Nov. 1	15.08
" 20	14.50	" 8	15.00
" 21 Sunday		" 15	14.87
" 22	14.50	" 22	14.62

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	18.75
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	16.53
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Nov. 16	6.50	Oct. 11	7.50
" 17	6.50	" 18	7.50
" 18	6.45	" 25	7.08
" 19	6.40	Nov. 1	6.92
" 20	6.40	" 8	6.84
" 21 Sunday		" 15	6.61
" 22	6.40	" 22	6.44

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	8.08
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	7.28
May	6.99	5.04	8.55	Nov.	8.05	6.76	....
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	44.43
Apr.	88.53	72.50	62.12	Oct.	78.82	54.82	40.47
May	100.21	72.50	54.17	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound

Date		Average week ending	
Nov. 16	6.80	Oct. 11	7.55
" 17	6.70	" 18	7.41
" 18	6.65	" 25	7.50
" 19	6.60	Nov. 1	7.54
" 20	6.60	" 8	7.31
" 21 Sunday		" 15	6.86
" 22	6.60	" 22	6.66

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	7.84
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	7.50
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Nov. 9	55.00
Oct. 26	65.00	" 16	55.00
Nov. 1	60.00	" 23	55.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	80.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	75.00
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	....
May	110.00	84.80	87.00	Nov.	120.00	78.00	....
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

CO-OPERATION AND RECIPROCITY

The whole social order is founded upon the principle of co-operation and reciprocity. If each person will comprehend that the market for his own products or services is dependent upon the ability of others to buy them, he will understand that the largest degree of prosperity for any group or class is obtainable in a state of general prosperity, when production and the exchanges everywhere are well-balanced, says the National City Bank.

It is a reasonable expectation that a readjustment of wages and prices must follow the war period, and it is apparent that this readjustment has begun. The farmers have already taken a heavy shrinkage in the prices of their products. They think it hard that their turn should come among the first, but although the farmer is not a plutocrat, he is a proprietor, an operator upon his own account, and people who have capital enough to be proprietors, be they large or small, are in better position to take the brunt of a readjustment than the wage-earners of the towns. It is impossible to ask the latter to accept wage-reductions until a reduction in living costs has taken place, and farm-products are the leading factor in the cost of living.

On the other hand, the price of farm-products having declined, it becomes a matter of common justice and also an essential factor in the maintenance of employment for the wage-earning class that the prices of what the farmer must buy shall come down in like proportion. Are they going to do so? That is the critical question at this time.

Every one is entitled to have his own opinion of the present industrial situation. A very influential labor leader has declared that labor must "resist, resist, and resist to the last" every attempt to reduce wages, and this is the position which organized labor is understood to occupy. The idea doubtless is that having won the advanced position represented by the present wage-level they intend to hold it at all hazards. It is, however, a mistaken idea, for if prices generally are falling and other people in the industrial circle are taking smaller pay for their services or products the workers who refuse to accept any wage reductions are really asking for more pay. Instead of being on the defensive, trying to hold their own, they are attempting to improve their position at the expense of other workers.

Furthermore, they will be attempting the impossible. They overlook the interdependence of industry. Consider the relations between manufactured products and farm-products. The market for farm-products is largely in the towns and the market for the town industries is largely on the farms. About one-third of the people of this country live on the farm. The exchanges are made by means of money payments, but unless farm-products are going to buy about as many town products in the future as heretofore, it does not require a professor of political economy to see that there will be a falling off in the consumption of town products and in the demand for labor to make them. And if 25% of the labor so employed should find itself walking the streets because trade had fallen off, it will be up to the labor leader to explain the advantages of that situation over a moderate reduction of wages which would have kept the farm and factory in balance, with better living conditions for everybody. Goods are not going to be made unless they can be distributed, and distribution cannot occur except upon a fair basis of exchange for all products.

MONEY AND EXCHANGE

Foreign quotations on November 23 are as follows:

Sterling, cents:	Cable	3 52¾
	Demand	3 53½
Francs, cents:	Cable	6 32
	Demand	6 33
Lire, cents	Demand	3.96
Marks, cents		1 58

Eastern Metal Market

New York, November 17.

Liquidation of sales of relatively small lots of various metals by some companies or producers in need of cash is the predominating factor in several of the markets. Rather than carry stocks some interests are converting at least a portion of them into cash where prompt or early delivery is involved. This situation has prevailed for some weeks and some markets which had not scraped bottom are lower, such as lead, tin, and zinc.

Copper is a little lower in a dormant market.

Tin has suffered further declines with London prices still falling.

Lead is again lower with consumption showing a decided decline.

Zinc is easier on offerings by interests anxious to sell small lots.

Antimony is lower.

IRON AND STEEL

With buying almost at a standstill, independent steel-company prices are still declining, in a few cases getting to the Steel Corporation level; most blast-furnace and steel-works capacity in all districts is idle, says 'The Iron Age'. Steel Corporation operations hold up to 80% or more, while independent plants are gradually running out of business. In northern Ohio some shut-downs are nearly complete. There is no thought of getting this year an adjustment of prices that will cause free buying and the period of quiet may run some weeks into the new year. To get stocks down to their lowest before January 1 is the aim of all users.

Interest is centring in the prices that the Steel Corporation will announce early in December on sheets and tin plates for the first half of 1921 and on rails for the year.

COPPER

There is a strong belief that the copper market is scraping bottom. Prices have gone a little lower since last week until now electrolytic copper is quoted at 14.75c., New York, for early delivery or delivery this year, with 15c. asked for first quarter. Some sales have been made at these levels, but demand continues small and there is not much life to the market. The lower prices are due to the forces which are referred to above—necessary liquidation by some sellers who do not care or cannot carry heavy stocks. Production is declining and so is consumption, but the cutting down of production at the mines is not as simple a problem as some imagine. While the entire situation is somewhat chaotic there are those who think the copper market has been liquidated. The same authorities hold a similar opinion as to tin and zinc.

TIN

Consumers are still out of the market and so are dealers, and on most days the past week there has been no business. On Monday last week, however, there was a fair volume done in spot and nearby or steamer-at-dock for which around 37.25c., New York, was realized. There was considerable inquiry but it developed that there were few sellers for this position. There has been some activity on the New York Metal Exchange, where about 150 tons was sold, mostly first-quarter shipment, at 38.50 to 38.75c., with one lot of spot Straits, in Pittsburgh, sold under the rule at 37.37½c. Banca tin is scarce and held at about the same level as spot Straits, which yesterday was quoted at 37c., New York, although it fell to 36c. on Monday. The London market was lower yesterday at £238 10s. for spot standard, £240 12½s. for future standard, and £242 for spot Straits, all much lower than a week ago. Arrivals thus far this month have been 2405 tons with 3675 tons reported afloat.

LEAD

This market has gone still lower, the recession being gradual. On Monday the outside market was around 6.40c., St. Louis, or 6.62½c., New York, with the leading interest at 7c., both New York and St. Louis, but very late Monday the latter reduced its price ½c. per pound to 6.50c., both St. Louis and New York. The fact that the official prices are at the same level in both localities is explained on the basis that import lead is still a factor in the New York market. The outside market is now 6.50c., New York, and 6.37½c., St. Louis. On the whole the market is dull and dormant. There has been an increase in supplies with more sellers active for orders. In fact one seller described the market as more of a buyers' market than "in an age". This is due to a falling-off in consumption with almost no improvement in production. Some say liquidation of this market is at an end, while others do not agree.

ZINC

Prime Western for early delivery is quoted today at 6.35c., St. Louis, or about 6.80c., New York, at which levels some sales are recorded. The market is not active but is confined to the immediate needs of some consumers. There have been sales at 6.50c., St. Louis, by some large producers who are not willing to shade this. There are, however, some 'weak sisters' who need the cash and are hence taking such business as is offered, even at a loss. There has been a decided curtailment in production with such companies as Anaconda, Butte & Superior, and others shutting-down their zinc operations. One large seller believes that, when nominal markets again rule, prime Western will sell around an 8 to 9c. level.

ANTIMONY

Spot or early-delivery antimony is again lower, the quotation having fallen to 6c., New York, duty paid, for wholesale lots. Jobbing parcels are ¼ to ½c. higher.

ALUMINUM

The market is inactive and unchanged. Virgin metal, 98 to 99% pure, in wholesale lots for early delivery, is quoted at 32.90c. f.o.b. producer's plant by the leading interest and at 28 to 29c., New York, by other sellers, representing foreign metal largely.

ORES

Tungsten: There is no interest on the part of consumers and no business. Quotations are largely nominal at $4 per unit for Chinese ore and $5 for Bolivian. The lower exchange-value is restraining foreign inquiries.

Ferro-tungsten is quoted at 90c. per pound of contained tungsten in guaranteed lump form, and 70c. in unguaranteed. In powdered form the quotation is 78 to 85c.

Molybdenum: Business is at a standstill with quotations nominal at around 75c. per pound of MoS_2 in regular concentrate.

Manganese: The market for high-grade ore is quoted unchanged at 45 to 50c. per unit, seaboard. There is no demand.

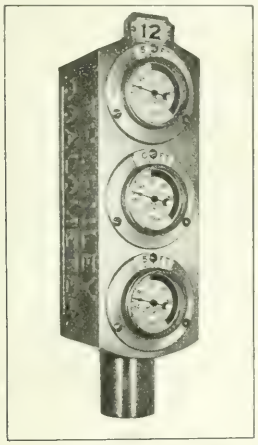
Manganese-Iron Alloys: The domestic and foreign producers' quotations for ferro-manganese are unchanged at $170, seaboard, as a basis, but there is no inquiry to test the market. Re-sale alloy is obtainable at $150 and it is believed that some British producers would sell direct at $150, seaboard, if the opportunity should present itself. Spiegeleisen is nominally unchanged at $75, furnace, for the 19 to 21% grade, with re-sale alloy obtainable at a concession.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

THE THORNLEY COALOMETER

Coal in storage has the property of spontaneously heating in certain spots and at varying depths. This heating does not always cause actual combustion, in the sense that coal burns with the presence of flame, though this condition is also often found. There does exist almost universally, however, in stored coal of this character a slow combustion, which is even more destructive than combustion by flame, owing to the fact that it cannot be so readily detected, and thus accomplishes its destructive heating, quietly and unnoticed, throughout an ever-increasing zone, beneath the surface of stored coal. This slower escape of the valuable



Head of Thornley Coalometer

B.t.u's., for which the consumer has paid his money, is equivalent to the actual loss of that amount of heating value from fire or other cause. Could the consumer look beneath the surface of his coal pile and definitely acquaint himself with conditions existing there, he could save himself enormous losses by using that part of his coal supply first which showed a tendency to become even slightly heated. In other words, he could burn the heat units which had started to escape before they had done so.

It is for the purpose of indicating these conditions beneath the surface that the Thornley coalometer was designed. It consists of a set of temperature indicators encased in a long pointed steel tube, carrying at varying depths metal bulbs (corresponding to the bulbs of thermometers), and at its upper end a set of indicating dials which show the exact temperatures of the bulbs which actuate them. These units are forced down in the coal pile to definite depths and at various points, and collectively furnish definite data as to the exact temperature existing beneath the surface. If an accurate record of these instruments be kept, periodically, the slightest rise in temperature is at once detected, and should it become excessive the consumer at once removes this particular portion of fuel, thus saving the heating value of the coal which had started to dissipate.

Tests have shown that one unit at 50-ft. intervals in both directions will efficiently indicate conditions of temperature below the surface. Thus the installation of one triple unit will protect a volume of coal 50 by 50 ft. at its base and of any depth. The cut shows a triple unit Thornley coalometer for use in coal piles from 15 to 20 ft. deep. A galvanized steel tube, having a hardened point at its lower end, carries three bulbs at depths of 5, 10, and 15 ft., respectively. These three bulbs register temperatures in Fahrenheit degrees upon three dials. The scale on each dial starts at 32°F., and is colored black. At and above 120° the scale is red, indicating excessive heat at any point in this zone, and warning the coal man to remove this portion of the coal. The depth of the hot spot is determined at a glance, for the dials are plainly marked 5, 10, and 15 ft., respectively. The dial showing the hottest temperature thus indicates the depth at which the heat is generating.

These instruments are enclosed in weather-tight metal cases with thick crystal faces and the set is mounted in a cast metal case, thus forming one unit. The unit head is shipped separate from its steel stem. Thus, the steel stems are forced into the coal at proper intervals until the surface lugs (so marked) are flush with the surface of the coal pile. After these stems are properly placed, the unit heads are easily attached, and the system is at once ready to show actual temperatures of the coal beneath the surface. Should any unit have to be removed, owing to the indication of excessive temperatures at that point, it is a simple matter to detach the instrument head from the steel stem, and then pull the stem from the coal.

With each set of equipment is furnished a leather-bound loose-leaf record book, each page of which covers seven readings of the indicated temperatures of each coalometer. These records furnish a complete knowledge of the conditions beneath the surface of the coal and enable the manager of such storage equipment readily to determine what portion of his coal is losing its heating value and at what rate. A column on this record sheet shows the exact date at which any unit was removed and the temperature of that portion of the coal at that time. It is easy to figure what losses will occur in dollars in your storage piles, at ever-increasing temperatures and through long periods of time, unless you are constantly posted as to existing temperatures beneath the surface of your coal. The Thornley coalometer was designed to furnish these data at all times with great accuracy.

GREAT THINGS EXPECTED OF NEW TYPE OF AIR-DRILL

The development of pneumatic mining and quarrying tools has been so rapid, and their performance latterly so efficient, that it is but natural they should now be regarded as having reached such a state of perfection that radical changes or improvements are, generally speaking, no longer expected. And yet, notwithstanding this popular notion, the Denver Rock Drill Manufacturing Co. has recently developed

a new type of light mining and quarrying drill which, it is claimed, marks an important advance in the progress of air-drill manufacture. This new drill is built in three models, known respectively as models NA-90, NRW-93, and NRD-95; the first named being a 'dry' auger-drill, especially designed for work in coal, iron, and other soft formations; the second, a combination 'wet' and 'dry' rock-drill efficiently serviceable in all kinds of rock and under all conditions either above or below ground; and the last named, a 'dry' rock-drill particularly adapted to work in wet shafts or where out-of-door conditions prevail.

All three drills are extremely light, so that they can be easily carried about, and each is operated by one man. They are built throughout of the best steels compounded and with the utmost precision. While most Waugh drills are of the valveless type the 'Nineties' are equipped with an entirely new type of spool-valve, having a positive action, which is said to be the last word in simplicity, and efficiency as well. The rotation mechanism is of exceptionally strong design in which stresses in both teeth and pawls are reduced to a minimum.

New Model Light Air-Drill

Lubrication is effected by pulsations of air which gradually feed the oil from a reservoir at the side of the cylinder into all parts of the machine. The manufacturers claim that comparative tests conclusively prove these 'Ninety' drills to be much superior, more powerful, and more efficient, at all pressures, than other drills of their general type and weight, and express themselves as feeling gratified at being able to make contribution to cost reduction in mining and quarrying at a time when the country stands in greatest need of labor-saving improvements in machinery.

COMMERCIAL PARAGRAPHS

L. M. Dozier has become salesman for the **Barber-Greene Company**; his headquarters being at the St. Louis office of the company.

'G-E Insulating Compounds' is a recent bulletin of the **General Electric Co.**, Schenectady, New York. It is an illustrated description of the many kinds and grades of these compounds, with much general information for their use and handling.

'General Fireproofing' is the title of a periodical publication distributed by the advertising department of the **General Fireproofing Co.** of Youngstown, Ohio. The August number discusses metal lathe from a number of aspects and is well worth reading by those who are engaged in any building occupation.

Two attractive bulletins recently published by the **Pennsylvania Pump & Compressor Co.** of Easton, Pa., are entitled 'Pennsylvania Centrifugal Pumps' and 'Pennsylvania Air Compressors'. The features of the design and construction of the machines made by the company are outlined, while a number of illustrations add to the value of the bulletins.

At a meeting of the directors of the **Empire Tube & Steel Corporation,** a resolution was passed to have Carl M. Beattie, president, open negotiations to secure a site which he has had under observation in Buffalo for the purpose of erecting a new plant. It is the purpose of the corporation to install in the Buffalo plant a number of machines that they have in storage, and at the present time have no space to utilize. In this way their business will not be interrupted by the moving of the plant from Long Island to Buffalo.

The new 'Eveready' catalogue, issued by the **Oxweld Acetylene Co.,** of Chicago, Illinois, is now ready for the public. This catalogue is issued in sections, each devoted to a particular phase of 'Eveready' equipment—welding and cutting blow-pipes, regulators, accessories, etc. The 'Eveready' line was formerly manufactured under the name of 'Prest-O-Lite' apparatus by the Prest-O-Lite company, and was extensively used in the metal trades. The Oxweld company took over the production and sales under the present name—'Eveready'—early in 1920, incorporating certain improvements in design lately developed in oxy-acetylene engineering.

It has been the constant endeavor of **Holt Manufacturing Co.** to build into its 'Caterpillar' tractors those features which will enable the purchaser to realize the greatest possible profit on his investment. Several years ago in studying the needs of the logging industry it was clearly shown that a tractor, to be truly successful, must have incorporated in its design an auxiliary winding-drum or winch-attachment. In the oil-fields this attachment is necessary to pull and run back-rods, tubing, and casings, as well as move equipment from practically inaccessible places. Realizing these requirements, Holt engineers began a study of the application of various commercial winch attachments to 'Caterpillar' tractors, but found them all entirely inadequate. Profiting from experience with these attachments the engineers began the design of a new type of winch attachment embodying those features which are found to be essential to practical operation in the various fields where 'Caterpillar' tractors were used. After several years a 'Caterpillar' winch was developed that met fully the most rigid requirements of oil-field and industrial service. Bulletin C-151 illustrates the application of this winch to various industries and contains a resume of the various specifications that have made it a real success.

Bulletin No. 40017A, issued by the **General Electric Co.,** describes belted, direct-current, continuous-rated generators and exciters, type ML, standardized from 1 to 35 kw., both compound and shunt-wound. When used as exciters they are flat-compounded at 125 volts; otherwise, they are compounded from 115 volts no load to 125 volts full load, unless a shunt-wound machine is desired. Up to and including 9 kw. they are also standard, shunt-wound for 35 volts, for storage-battery service. The armature core, clamped by bolts, is built up of thin steel laminations, carefully annealed, and given a special insulating coating which practically eliminates eddy currents. The coils, form-wound and thoroughly insulated, are protected by end cylindrical flanges. The commutator, of punched rolled copper bars of high conductivity and insulated with selected soft mica, affords commutation without injurious sparking at all guaranteed loads. The pole-pieces are built up of steel laminations slotted parallel to the shaft to minimize eddy-current losses and prevent undue distortion of the magnetic field under load. They are cast-welded to the yoke to minimize field magnetic reluctance. The brush mechanism is the adjustable rocker-arm type. Bearings are ring-oiling. Two slip-rings with brush-rigging and a single-phase auto-transformer constitute three-wire parts.

T. A. RICKARD, ... Editor

BROKEN HILL is at work again, the strike having ended on November 10. This strike began early in May of last year, so that it lasted more than 18 months, making a most unenviable record. The loss in profits to the mining companies and in wages to the employees is estimated at $60,000,000. A settlement was effected finally by Judge Edmunds, who was appointed for the purpose by the governments of Australia and New South Wales, the State to which the Broken Hill mining district belongs. The whole affair was as stupid as it was deplorable.

MONEY is tight everywhere. We note that in London the Mexican Corporation offers five-year notes to the amount of £400,000 at 8% and redeemable at a premium of 15%. This corporation is an 'exploration' company organized to acquire and develop mines in Mexico. We note also that the shares of the National Mining Corporation are at a discount of 50%, the quotation being at 5 shillings for the £1 shares on which only 10 shillings has been paid. Presumably the liability of 10 shillings per share is a deterrent to purchase, most people being averse from holding stock carrying an obligation of this kind. The National Mining Corporation was launched a year ago as a consolidation of the most important mine-promoting agencies in London and among its directors are a number of the most influential mining men in the City. It has a capital of £3,000,000 in £1 shares, of which 2,500,000 shares were taken by the directors and their friends, leaving 500,000 shares for subscription by the public. These shares were issued with five shillings paid on allotment and an understanding that calls for five shillings each would be made at intervals of not less than two months. Since then the second call has been made. It is stated that important business is in hand, for which the Corporation will need all the money it can command. We believe that it is looking to Mexico for its principal field of operations.

ON December 1 General Obregon assumed office as President of Mexico. We wish him every success in his greatly important duties as Chief Executive of our neighbor republic and hope that either on the day of his inauguration or soon afterward his government will receive formal and friendly recognition from our government. As a sign of the times, favorable to President Obregon's administration, we note that the striking coal miners in Coahuila have turned the mines back to their owners, doing this at the order of the Mexican government. The strike began on October 11 and was followed by an entirely unsuccessful attempt on the part of the recalcitrant miners to run the mines themselves. Likewise we note that the workers at the metal mines of northern Mexico are refusing to accept the 'infalsifiable' paper money in payment of wages, asking instead that they be paid in silver pesos. We hope that the Obregon government will accept this as another reason for coining the silver produced in Mexico, which step has been urged by Mr. Charles Butters and is to be recommended for the further reason that it will compel the owners of silver mines to export products other than silver, thereby stimulating the general restoration of industry in Mexico. To the new President we wish good luck. He starts well; he has intelligence, courage, and the intention to do right; he realizes the danger of militarism and the difficulty of creating an honest bureaucracy; he is a soldier and a statesman; he ought to succeed.

FURTHER fall in the quotation of copper shares has followed the continued decrease in the price of metal; in many cases the share quotations are now below the low figures reached on the day after the outbreak of war in Europe, and they are from one-half to one-quarter of what they were at their highest in 1916. Unfortunately some of the American copper sold abroad, in Japan and Europe, early this year, was re-sold later or still remains undelivered. In the first eight months of the current year our exports of copper amounted to 438,875,000 pounds, this being at the rate of 658 million pounds, or 43.8% of the production, which is estimated at 1500 million pounds, or 300 million pounds less than in 1919. Although the copper mines of the United States are operating today at about half-capacity, their output is close to that of the three years preceding the War. What has ruined the market is the lack of big European purchases such as those in the years just before the War when Germany was preparing for the great struggle by accumulating a large stock of metal. At that time exports represented over half of our domestic production; in 1919 exports took only 28.2% of the production. Meanwhile during the War the output was enormously stimulated, so that in 1918 it reached 2432 million pounds, this being an increase of 50% over 1913, the year before the War. In that year we exported 53% of the

copper we produced; last year only 28.2%; this year probably 43%. No real change in the market can be expected until peace is ratified with Germany and economic conditions in Europe are restored to some measure of normality.

EASTERN SIBERIA is a land of fabulous wealth, on the principle of the proverb that says, "The oxen farthest from home have the biggest horns". We know something about that part of the world and therefore were not overwhelmed mentally by the highly colored description of the concession said to have been obtained by the Mr. Vanderlip who was not the Mr. Frank A. Vanderlip of New York but an adventurer from Los Angeles. It appears now that an opportunity of sharing in potentialities of wealth beyond the dreams of avarice was offered to that sagacious old sailor, Capt. Robert Dollar, of San Francisco, a man of keen intelligence and wide experience in business affairs—indeed, one of the merchant princes of the Golden Gate. He declined Mr. Washington D. Vanderlip's offer because he believed that the concession would not be validated in behalf of its American holders, and because any attempt to validate it would lead to war with Japan; moreover, the Soviet government insisted that the widest publicity should be given to the affair in order to swing American sentiment to their side, upon which Capt. Dollar remarked, "There's too much brass band in this". So he relinquished his chance to exploit Kamchatka, a beautiful peninsula delightfully described in Mr. George Kennan's 'Tent Life in Siberia', one of the best books of travel ever written. It seems to us that Capt. Dollar showed characteristic good sense. Meanwhile it is interesting to note, according to recent dispatches from London, that the government of Lenin and Trotzky invites foreign capitalists to assist them in exploiting the resources of Russia, that is, they acknowledge the failure of communism to produce the raw materials needed for domestic manufactures and actually welcome the invasion of foreign capitalism to correct the deficiency.

The Flotation Conference

The recent successful convention of the American Mining Congress at Denver was rendered particularly memorable by a special conference on the present status of flotation, not the state of the art but the conditions created by the tactics pursued by the Minerals Separation company and the unpleasantness ensuing therefrom. Mr. George E. Collins presided, efficiently and gracefully. The proceedings were given point by the presence of three official representatives of Minerals Separation, namely, Mr. Alfred D. Cook, attorney and director, Mr. E. H. Nutter, chief engineer, and Mr. Chester B. Allen, secretary to the Minerals Separation North American Corporation. At the opening session Mr. Collins delivered an interesting address, reviewing the history of the process, with special reference to the Everson episode in Colorado and recording his own early participation in experimental work. Then followed several indictments of Minerals Separation, which was placed in the position of a defendant while gentlemen on the other side fired broadsides loaded chiefly with testimony elicited in the hearings before the Federal Trade Commission; indeed, the 'conference' had the air of a courtroom while two of the lawyers representing the American Mining Congress before the Commission, Mr. George L. Nye, of Denver, and Mr. Gilbert H. Montague, of New York, arraigned the patent-exploiting company. We shall publish their addresses in due course. Mr. T. A. Rickard was asked to speak, but waived the privilege, suggesting that the interest of the proceedings would be heightened if one of the gentlemen on the other side were to reply. Even an opponent could appreciate the unpleasant position of Messrs. Cook, Nutter, and Allen, who had been invited to attend, and who had shown courtesy in coming to the conference, only to find themselves excoriated for their misdemeanors. The chairman invited Mr. Nutter to reply, but Mr. Cook rose to state that they preferred to postpone a response until later, when the attack had been concluded. The afternoon session was marked by an eloquent speech from Mr. Cook, who endeavored skilfully to rebut the evidence adduced against his clients. His statement was interrupted by Mr. Montague, who insisted upon a categorical reply to the question as to whether on the expiration of No. 835,120 the Minerals Separation company would cease collecting royalty from their licensees on the process (less than 1% oil) covered by that patent. Mr. Cook replied that he was not a patent attorney and disclaimed authority to reply to Mr. Montague's question, undertaking, however, to telegraph to Mr. John Ballot, the president of the company, in New York, for an official statement. At the following session, next morning, Mr. Cook read his telegram to Mr. Ballot and the reply thereto. They were as follows:

"Do we claim that if a licensee uses first patent in suit after its expiration in 1923 and operation thereafter does not come under other patents that he must continue to pay royalties to us?"

"The answer to your question is 'No' we do not claim payment of royalty in suit or on any other patent at time of expiration, but we do claim royalty for any other unexpired patents."

Mr. Montague expressed great gratification at Mr. Ballot's telegram, characterizing it as "magnificent" and more than justifying all the efforts made by the American Mining Congress in behalf of flotation users. Mr. Oscar Rohn also expressed satisfaction and remarked that he had no animosity against Minerals Separation. The next speaker was Mr. Nutter, who placed stress on the valuable service performed for the mining industry by his company's testing laboratory in San Francisco and described how he and his associates had persuaded the Arizona and Inspiration mining companies to adopt the process, thereby introducing the successful application of the process in this country. A further altercation between the lawyers was checked by the chairman, who called upon Mr. Rickard to speak. He began by saying

that he had not been in any hurry to join in the attack because he had had ample opportunities for doing so elsewhere, and he had availed himself of them freely. He made a plea for intellectual honesty, insisting that without it the conference would get nowhere. He demurred to Mr. Rohn's disclaimer of animosity, insisting that there was plenty of animosity against Minerals Separation, and for good reason. Personally he was much prejudiced against them, but the recognition of his own prejudice did not prevent—it probably helped—him in being fair. As to the "magnificence" of Mr. Ballot's telegram, he thought that interpretation ridiculous; it needed no lawyer to see that the Minerals Separation company could not collect royalty on a patent after it expired and that the expiration of No. 835,120 promised no particular relief because 67 other patents were owned by Minerals Separation. The complexities created by the effort to interpret No. 835,120 were as nothing to the confusion worse confounded that would follow from the impending litigations over the patent for a soluble frothing-agent. As to Mr. Nutter's research laboratory and its usefulness to the industry, it was to laugh. In regard to the first application of flotation to chalcocite ore, it was a fact indeed that the Minerals Separation people had been the first to demonstrate the amenability of this class of ore to flotation, and credit was due to Mr. Nutter personally for this particular achievement, but it was to be remembered that he did this in 1915, that is, nine years after the grant of the patent. The delay in the successful use of flotation in this country was due in large measure to the Minerals Separation company, whose metallurgists had stated in print that the froth-agitation process was not suitable for chalcocite ores. However, he did not desire to belabor the point; it seemed to be about time to recognize the impasse into which the flotation contest had drifted and to endeavor to lift the quarrel out of the morass of litigation. As one wholly detached from personal interest in the matter, he ventured to place a proposal before the conference, namely, that all the patent-rights of the Minerals Separation company be purchased by a syndicate, composed preferably of those representing the principal so-called infringers. Whatever the sum required to make the purchase, a large part of it would be met by a royalty levied on the tonnages already treated; the remainder would be amortized by the collection of royalty for a period of years long enough to permit the purchase to be redeemed, with current interest on the capital involved. Thus in five or ten years the industry would be relieved from the burden of litigation, and the greater incubus of inquisition and interference by the patent-exploiting agency, while the present litigants would find a reasonable solution of their troubles. In order to lift the settlement above a merely commercial and litigious level he suggested that the royalty, to be levied until the cost of purchase had been redeemed, include one cent per ton for the purpose of endowing a research fund, and the establishment of a central laboratory for progressive experimentation in flotation. Mr. Cook rose to thank the Congress for its courtesy to him and to his associates. The meeting closed by the reading by Mr. Philip Argall of a paper on recent improvements in the treatment of ores by flotation. The contentious phase of the meeting was over and it remained only for the directors of the American Mining Congress to take action on Mr. Rickard's suggestion. This, we understand, was done in due course, the new president, Mr. W. J. Loring, being authorized to nominate a committee for the purpose.

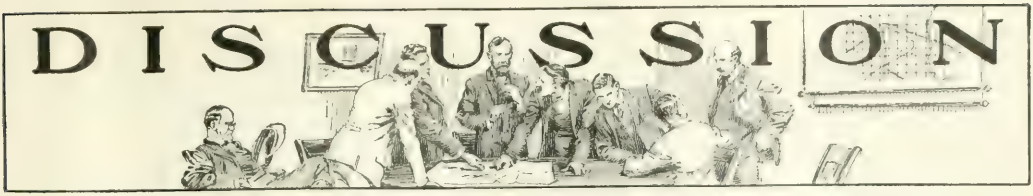
Curtis H. Lindley

The death of Judge Lindley is more than a personal loss to his many friends, it marks the close of a career of great public usefulness. The Bar Association of San Francisco has expressed its respect for him as a lawyer. The president of that Association stated: "In his passing the Nation lost one of its most patriotic citizens, the State of California one of its most useful sons, the city of San Francisco one of its most trusted advisers in matters of great public concern, and this organization one of its hardest workers and its brightest ornaments." On the front page of his treatise on 'The American Law Relating to Mines and Mineral Lands' Judge Lindley quoted Bacon's admonition: "I hold every man a debtor to his profession; from the which, as men of course do seek to receive countenance and profit, so ought they of duty to endeavor themselves, by way of amends, to be a help and ornament thereto." He lived up to this precept; most assuredly he proved himself a help to his colleagues and an ornament to the profession itself. His treatise, usually known as 'Lindley on Mines', will remain an enduring monument to his industry, intelligence, and intellectual power. The first edition was published in 1897, and the second in 1903. The earthquake-fire of 1906 destroyed the plates of the second edition and the much more valuable notes already gathered for the publication of a third edition. It was a hard blow to our friend, but his courage rose superior to adverse circumstances and he proceeded indomitably to re-assemble the material for the third edition, which appeared in 1914. He was president of the San Francisco Bar Association for four years, president of the California Bar Association for two years, director of the Panama-Pacific Exposition of 1915, and a Park Commissioner; he was always ready to give the benefit of his advice in public matters and he was constantly consulted privately on affairs of great moment. In 1917 he became legal adviser to the Food Administration and drafted the bill creating the U. S. Grain Corporation. He assisted Mr. Hoover with his characteristic loyalty and sincerity, working so hard during the hot summer at Washington that he returned home an invalid. From this illness he never quite recovered; he was as truly a casualty of the War as if he had advanced with our troops in the Argonne; he was a faithful soldier and answered the call of duty as truly as if he had fought in the trenches, and with scarcely less danger to his life. On his return to Washington, after an absence of a year, he was crippled by ill health and yet would not abate his devotion to pro-

fessional duties. He continued to engage in sundry important litigations, the two latest mining suits in which he participated as senior counsel being the Bingham and Oatman cases. It gratified him greatly to win the former, for he had become impressed by the apparently fortuitous character of judicial opinions. He had just finished his part in the Oatman case, a cross-examination of the principal expert on the other side, when he was stricken with an internal hemorrhage, an hour after returning from the court-room to the hotel at Kingman, Arizona. He died as he wished, in harness. To mining engineers he was known as the most distinguished of the lawyers engaged in unraveling the complexities created by the effort to reconcile the apex law with geologic structure; in 1917 he was retained as an adviser in a famous British suit arising out of an apex litigation in Rhodesia; he was counsel for a number of important mining companies, among which we may mention the Bunker Hill, Alaska Treadwell, Alaska Juneau, Kennedy, Argonaut, North Star, Nevada Consolidated, and Inspiration. To others it has been permitted to achieve distinction in the law; Judge Lindley won a finer fame and a rarer record as a good citizen. In a republic, that is the supreme achievement. In days when cheap politicians slapped their chests and proclaimed themselves American, it was a relief, and is now a stimulating memory, to think of the Judge as the exponent of the American ideal of unremitting industry, undeviating integrity, alert intelligence, and devoted public service.

Electrolytic Zinc

Those who have tried to obtain trustworthy information concerning the technology of the electrolytic method of extracting zinc from its ores will have discovered to their chagrin that the superintendent or manager is usually quite willing to talk about his roasting and leaching processes, about his cathodes and his anodes, but when questions are asked concerning the purification of the electrolyte and the means employed for correcting the fouling of that metallurgical medium, he becomes evasive if not silent; in short, it is almost impossible to obtain detailed information concerning the critical part of the refining process. Therefore we take especial pleasure in publishing a comprehensive article on the subject by Mr. Herbert R. Hanley, who has been directing metallurgical operations, and the research incidental thereto, at the Bully Hill smelter in Shasta county, California. He describes the technique of the process whereby zinc is obtained electrolytically from ores and from smelter by-products. The successful application of electrolysis to the precipitation of zinc from a sulphuric-acid solution on a large scale is comparatively new, and, while much has been written regarding special features of the operation and numerous plants have been described in a general way, there was need of a comprehensive discussion of the problems that are presented and the methods by which difficulties may be overcome, such as Mr. Hanley gives our readers. He speaks with the confidence of one who has actually applied his technical skill to commercial operations and his conclusions therefore may be accepted as authoritative, at least in the light of our present knowledge; it is imprudent, of course, to imply that any metallurgical process has been perfected. The recovery of zinc from a sulphide ore includes a series of preliminary operations each of which has a direct bearing on successful electrolysis. These are roasting, leaching, filtering, purification, and a second filtration just before the electrolyte enters the cells. The best roasting is accomplished when the zinc sulphate in the calcine is just sufficient to balance the acid-losses in the subsequent steps of the process, provided, of course, that there is produced a maximum amount of zinc soluble in acid. The technique of efficient roasting is discussed briefly. Leaching is done in a Pachuca vat. Cyanide operators might be inclined to take exception to the practice of calling this operation leaching; leaching rather implies percolation, whereas this process is one of agitation and filtration entirely analogous from a mechanical standpoint to the slime-treatment of gold and silver ores, except that the time required is short. Some of the contaminating compounds of iron and antimony are precipitated at this stage of the process by the addition of sundry oxidizing reagents. The first filtration is commonly done by means of a continuous vacuum-filter; silica, alumina, and some salts of iron, if present, retard the filtering and it is accordingly desirable to remove them as completely as possible in the leaching process, which, if properly regulated, does this satisfactorily. The next step, the purification of the solution, is the critical phase of the whole process. It is easy to precipitate zinc from a solution of nearly pure zinc sulphate by means of an electric current; but exceedingly small amounts of contaminating salts of copper, cadmium, and some other metals can spoil the result. Not only do they produce a spongy impure deposit on the cathodes, but they promote the re-solution of the deposited zinc, and may reduce the current efficiency to a prohibitive extent. Mr. Hanley goes into detail regarding this vexing problem and describes the chemical precipitation with zinc-dust as the standard method used at present. An electrolytic precipitation is technically possible, but the expense of erecting and operating the necessary equipment would not be justified under ordinary conditions. Purification is done by agitating the filtrate with zinc-dust in a Pachuca vat, while a pressure-filter serves to remove the small quantity of precipitate formed, leaving the neutral filtrate ready for the electrolytic cells. The regulation of current density, acidity, temperature, and electromotive force has been the subject of considerable research, the results of which are shown in a series of eleven typical curves that indicate clearly the effect of varying the different factors. We believe that Mr. Hanley's article will be of value to the engineer who must have a general knowledge of the electrolytic metallurgy of zinc, no less than to the metallurgist who is engaged in the operation of an electrolytic plant. It is a rare combination of practical and technical information, presented with care and precision.



The Belmont Shawmut Mill

The Editor:

Sir—In your issue of November 6 appears an interesting article on the operation of the mill of the Belmont Shawmut Mining Co., by A. B. Parsons. In the article several points are brought out that especially appeal to the engineer, perhaps on account of the difficulty of explaining the why's and wherefore's: First, the statement that the pebble-consumption was 1.3 lb. per ton of ore when the pebble-load was maintained at a point 10 in. below the centre of the tube, and the pebble consumption was only 0.3 lb. per ton of ore. This wide difference in pebble wear is unusual and the only plausible explanation is that the grinding capacity of the tube-mill, when charged with pebbles to the centre line, was too great for the feed introduced, the pulp circulating through the mill not being sufficient to properly cushion the pebbles, and thereby causing an undue contact of pebble against pebble.

A second point brought out was the importance of using sodium sulphide in the flotation-circuit; that the use of this reagent might serve to improve the grade of the flotation-concentrate by deflocculating the gangue is apparent, but just why the recoveries should also show marked improvement is more difficult of explanation because gold when associated with sulphide or when free and liberated from the gangue in a fine state of division usually yields itself readily to the ordinary flotative reagents.

Thirdly, the statement is made that mixing the fine raw flotation-concentrate with granular roasted concentrate has three important results; first the cyanide consumption is reduced, secondly, the recovery on the roasted product is slightly improved and, thirdly, that an increase of over 30% is effected in the recovery on the raw flotation-concentrate as compared with the recoveries made when treating the calcined and flotation-concentrate separately. The slightly improved recovery on the calcined concentrate when agitated with the fine flotation-concentrate may be explained by a lesser tendency of the combined product to stratify and becoming of too great a density in the lower part of the agitator for efficient dissolution of the precious metal. The great improvement in the extraction on the raw flotation-concentrate is more difficult of satisfactory explanation. Mr. Parsons mentions that before putting a fresh charge into the agitator an excess of ferrous sulphate is used to kill all free cyanide. It is possible that this and other similar soluble salts present in the calcined ore, alone or combined with the scouring effect of agitating the coarser and finer material together, may have a tendency to free the raw concentrate from adhering oil-films, which would make the raw concentrate amenable to the action of cyanide solution. The rejection of oil from the circuit in the agitator-overflow would normally reduce the consumption of cyanide. It may also be that insufficient oxygen is taken into the pulp when agitating the raw flotation-concentrate alone. Mixing the two products, one being reducing and the other oxidizing, may set up an electro-chemical action that would accelerate the solution of the gold. The calcined product is delivered to the agitator at a temperature much above that of the raw concentrate. The temperature of the combined product would therefore be considerably above that of the flotation-concentrate drawn from the thickener. This change in temperature would no doubt result in improved recovery, but would hardly account for the full increase in extraction.

HENRY HANSON.

San Francisco, November 18.

The Rod-Mill

The Editor:

Sir—In a recent issue you mentioned the possibility of an improved rod-mill that might supercede the ball and tube-mills of the present day. You gave no details, and as our company, the Mineral Creek Copper Co., with mines in the Cascade mountains, within three hours ride from here, has installed such a mill which is doing excellent work, it may be of interest to your readers to know something about it.

It was patented four or five years ago and is a balanced-rod grinding-mill made at Tacoma, Washington, at Provo, Utah, and at Vancouver, B. C. It occupies a floor space of six by eight feet and is six feet high, set in a dust and water-tight case so that it can be operated wet or dry without any inconvenience to the workmen. There are two bearings outside this case easy to oil and get at. The main shaft is 7 ft. 6 in. long and 4½ in. diameter. There are two heavy steel castings keyed near the centre of the shaft, two feet apart and having circular openings 60° apart, 16 in. diameter, in which are placed 25 to 40 1 and 1½-in. rods four feet long. The entire lot of rods weighs from 2½ to 3½ tons. The circles are 4 or 5 in. wide and 1 and 1½ in. thick, which form tracks or rings for the rods to roll and tumble in as the mill revolves.

The construction is such that the mill is nearly balanced and requires only two horse-power to operate.

Between each set of rods is a 6-in. strip of ⅜-in. boiler-plate extending from end to end of the mill, which acts like elevator buckets to carry the overside up and feed it through the rods. There are twelve sets of screens 8 in. by 3½ ft. and as soon as the material is crushed to size it leaves the mill.

We run the mill at a speed of 25 r.p.m. and have 28 ft. of 40-mesh steel battery-screen in use. We can easily mill from 2 to 3 tons per hour from the crushers which are set to ⅜-in. mill-feed. There is little wear on the rods, screen, or mill, and it makes an exceedingly simple construction, as it avoids the use of elevators, conveyors, screens, classifiers, de-waterers, and thickeners.

R. L. Parker.

Tacoma, Washington, November 17.

The Ore Deposits of Mexico

The Editor:

Sir—Having had occasion to review a mining report on a mine in Zacualpan district, Mexico, in which reference was made to the articles on the 'Ore Deposits of Mexico' by S. J. Lewis that you published recently, I searched my files and read with much profit the article describing the above named district. Finding it unusually instructive I was led to go back and read *all* of the contributions in sequence.

My purpose in this communication is to ask if you will not, in future, by short editorial paragraph, draw attention of your readers to matter of this kind, paticularly where it appears as in this case, over a period of eight months, interrupted between numbers II and III by fully three months.

Articles as deserving of attention as Mr. Lewis's are worthy of more than one editorial reference, and busy men among your subscribers will thank you for a reminder which will lead to picking up some desirable reading matter that otherwise may be overlooked.

At the present time Mexican mining is surely coming into its own, unless all signs fail, and stimulation on your part to further contributions from those who are competent to write about Mexico is one of your duties to your readers.

F. L. Sizer.

San Francisco, November 12.

The Price of Gold

The Editor:

Sir—In the 'Press' of October 30, Mr. W. B. Chomley has a note on 'The Price of Gold' in which he fails to note the dual features of gold, namely, price and value.

Price is the mask which hides the value. To illustrate, I quote from your editorial column of March 20:

"Evidence introduced in a London police court against seven persons, one of whom is described as a gold miner, shows that 110,000 sovereigns were withdrawn from the Bank of England and melted into bullion, *which was then sold at a premium.*"

These persons didn't melt up the sovereigns as a metallurgical experiment, nor was the destruction of King George's likeness only a matter of vandalism. These persons were after a profit. They knew what many close students of the subject know, that gold has a price and also a value, the price being stamped upon coins as a mask to hide the value. The culprits in this case merely melted the mask and exposed the value.

The price of gold today is $20.67 per ounce; the value is more nearly $45 per ounce.

P. A. Robbins.

San Francisco, November 6.

[The British sovereign, in London, is worth more dead than alive, that is, its bullion value is greater than its coinage value. This is not true of an American gold-piece, which remains at a price proportionate to the amount of bullion in it, at $20.67 per ounce. The British paper sovereign is at a discount commensurate with the premium on gold, in Great Britain. The U. S. $5 paper bill remains at parity.—Editor.]

Mr. Hoover's Biography

The Editor:

Sir—A few lines in reply to Mr. Field's letter in your issue of November 13. Apart from my error in saying that there was no office operated by Bewick, Moreing & Co. at Coolgardie, I do not feel inclined to retract what I wrote in your issue of August 28. Mr. Field spoke generally in his biography in the 'Sunset Magazine'; now he specifies where the single-jack drilling method was adopted in Western Australia. I have sent copies of the 'Sunset' for July to friends in Australia, and they considered the matter in the same light as myself. An Australian in British Columbia first drew my attention to the article discussed, so apparently I am not the only one who regarded the matter as a slight on Australian methods. What riles me is such passages as: "A man over thirty can't stand Australian climate and living conditions, they say, and it takes a man of seventy-five to handle their problems down there." . . . . "Mining there was in the kindergarten stage of sixty years ago in California. It fairly made an American engineer weep." . . . "They refused to use the new tools; they flung them into the machinery of the stamp-mills . . . ."

I wish it to be remembered that in this discussion I am not trying to depreciate Mr. Hoover in any way, far from it; I simply want Australians to get fair play. And as I was one of the very few metallurgists that wrote on Australian practice from 1906 to 1913, as you will confirm, I feel it a duty to continue to do so in America.

Max von Bernewitz.

New York, November 17.

During the War 83% of the platinum consumed in this country was used in essential industries (chemical, electrical, and dental), but in 1919 only 40% was so used, and the quantity used for jewelry increased from 12 to 56%. The remaining small percentage was divided among several minor uses.

Electrolytic Zinc Methods

By Herbert R. Hanley

Introduction. The development of processes that have had practical application in the production of electrolytic zinc have received a great stimulus during the past five years. The subject had received considerable attention two or three decades ago by many investigators, and most processes evolved at this early date were based upon principles which are followed, to a considerable extent, in current practice. The study of these principles has given a better understanding of them and has led to the formulation of a few new ones and also to the deduction of a few corollaries. The development of methods that have economic application, however, has been the greatest factor in the growth of the industry.

The technique of electrolytic zinc has received considerable attention in the literature of the profession during the past few years, and anyone attempting to write on the subject is likely to indulge in considerable repetition, but to the extent that this appears necessary for illustration, I shall make no attempt to avoid it.

The economic electrolytic deposition of zinc from solution is an operation that must be performed in the electrolyte containing this metal as a sulphate, in the absence of certain other substances or with a limited amount of them. This is an essential fundamental condition. It is now generally recognized that the earlier processes for the production of electrolytic zinc did not have dependable and economic methods for the purification of the solution. There are many other factors of vital importance, but they are secondary to those involving purification, which if not effectual will cause a defeat of the purpose in hand. With this idea as a premise for the economic production of electrolytic zinc, the various steps of the work will now be considered.

The principal source of raw material is the zinc sulphide or oxidized zinc ores. A minor source at present, but which may become an important one, is represented by condensation products from smelters collected in bag-houses or by means of the Cottrell precipitator.

Preparation of Zinc-Sulphide Ores. Roasting. A better understanding of the conditions required in the roasting of zinc ores has led to the production of a calcine that has a smaller percentage of zinc insoluble in dilute sulphuric acid than was formerly the case. The extent to which this insoluble form of zinc is present in a calcine varies with the composition of the ore and the condition of the roast.

In the purification department there are certain losses of solution containing zinc. Incidental to these losses there is also a loss of potential sulphuric acid represented by the sulphate radical of the zinc-sulphate solution. To the extent this potential sulphuric acid is lost, new acid must be introduced, either in the form of purchased acid or by the formation of potential acid in the calcine, which is represented by the formation of zinc sulphate. All zinc plants strive to obtain a balanced system in regard to sulphuric acid; that is, efforts are made to form, by sulphate roasting, sufficient sulphate of zinc to balance the acid losses taking place in other departments.

There are several factors governing the amount of zinc sulphate formed in the roasting-furnace. These factors include the quantity of air that can come in contact with the particles of ore, the percentage of iron in the ore, the character of the iron-sulphide crystallization, and the temperature at which the operation is performed. C. A. Hansen has done some valuable work on the roasting of ores and has made important contributions to the literature on the subject.* He has pointed out the rôle played by iron in the formation of sulphate, and particularly the effect of isomorphous crystallization of iron and zinc, as well as many other important factors. This subject embraces a field too large for discussion in this article.

The subject of rabbling is one that operators regard with great importance because it is responsible for the oxidation of the ore particles. The roasting of a given type of ore containing approximately 25% zinc, 15% iron, and an amount of sulphur that would indicate the absence of isomorphic crystallization of these two metals, when carried out under uniform conditions except for the degree of rabbling, will yield a calcine with a wide variation in the proportion of zinc sulphate formed. An increase of rabbling in the zone where the first atom of sulphur is being volatilized, including the subsequent area where there is considerable exothermic action, in a measure minimizes the amount of acid-insoluble zinc compounds. This method of rabbling saves a certain amount of zinc that can be converted into soluble oxide and sulphate where conditions are favorable for their formation. The admission of a large amount of air is directly reflected in the low sulphur di-oxide content of the roaster gases, and this condition is necessary for the formation of zinc sulphate.

The calcine produced from ores containing above 16% lead usually has a lower percentage of total soluble zinc. This condition may be due to the influence of the lead or to the crystalline condition of the iron, or a combination of both.

Smelter-Fume. The condensation products from bag-houses or Cottrell precipitators, when operated in conjunction with blast-furnaces treating copper or lead ores, frequently have a high zinc content. If this product, which may be termed 'fume', contains some of the more valuable metals that are recoverable as by-products, then the treatment of this oxidized material for the recovery

*Bulletin A. I. M. E., August 1919.

of zinc electrolytically becomes an important matter.

Bag-houses in general produce a fume containing a larger amount of arsenic than is usually present in the zinc ores offered for treatment in an electrolytic zinc plant. The treatment of the fume in this kind of plant involves first the separation of the arsenic. The selection or development of methods to carry out this step will be influenced by the oxidation state of the arsenic. If this element is uncombined with other metallic bases and is in the lower or trivalent state of oxidation, it can be volatilized by heat alone. If combined with other bases, however, then more involved methods must be employed for separating it, inasmuch as simple heat-treatment will not then be found effective.

In this article the fire method only will be considered for the separation of arsenic from the fume.

It is well known that if sulphuric acid is mixed with an arsenical zinc fume in proper proportion to unite with the bases that are in combination with the arsenic as arsenites and arsenates, there is a volatilization of a certain amount of the arsenic during the roasting of this mixture, and the zinc is converted into sulphate. The amount of sulphuric acid required for such work will vary with different kinds of fume, but it will be represented usually by a quantity calculated to combine with the valuable metallic bases that can enter into solution. In this case zinc is desired in solution, and the sulphuric acid is mixed with the fume in an amount corresponding to its equivalent combining weight with this metallic base. A slight excess of 10 to 15% sulphuric acid is usually added to make up for acid losses incurred by its combination with other inherent bases.

The mixing of the fume with dilute acid is an operation that is by no means simple. There is a tendency to form cement-like solids during the mixing of these substances, and this troublesome condition must be largely overcome to conduct the operation economically.

Roasting of the Acid-Treated Fume. There is a progressive conversion of iron compounds to sulphate as the roasting proceeds during the first half of this operation, after which there is a gradual oxidation of the ferrous sulphate to ferric oxide. The copper compound is converted progressively into sulphate throughout the entire roasting period, and becomes maximum at the time of discharge. There is only a slow volatilization of the water-soluble arsenic during the first quarter of the period, then it becomes eliminated quite rapidly. Table I shows the changes taking place during roasting.

The elevation of the temperature is made progressively and care must be taken to avoid sintering near the zone of heat introduction. Low temperatures are maintained during the roast to avoid crusts, which would be readily formed if abnormal rises of temperature were permitted. The initial temperature of 330°C. is present on the second hearth and approximately 510°C. on the seventh or lowest hearth. When the seventh hearth is cooler than the sixth, there is an increase in the water-soluble iron noted on the former; in other words, there is a consistent reduction of iron from the water-insoluble form on the sixth to a water-soluble condition on the seventh hearth when the temperature is as above stated. This is overcome by maintaining the two lower hearths at approximately the same temperature.

Leaching. The treatment of the calcined zinc-bearing material, whether obtained from ore or as a bag-house product, is an operation that is devised to meet the requirement of separating the soluble zinc compounds from the solids. The method of performing the operation will vary with the character of the calcine.

The so-called Pachuca tanks (or Brown agitators) are generally used for this purpose; they are more simple, they are of larger capacity, and require less repairs than other vats of the kind. Under certain conditions agitators of the paddle type are indicated; these treat a smaller quantity of material and require more repairs.

The length of the leaching operation is governed by the rate of solubility of the zinc in the solution. If this rate is slow, then a long leaching time is implied. In some plants this is done by more or less continuous leaching in a series of vats, thus giving a prolonged contact between the calcine and the solution. The complete leaching of water-soluble zinc salts from a calcine is accomplished in a few minutes, and any prolonged period of leaching does not accomplish further solution.

The zinc that has gone into solution from the calcine represents the percentage solubility referred to the total zinc and should not be termed 'recovery', because this term, when used in an unqualified manner, signifies the amount of metal produced in marketable form referred to the total zinc in the raw material entering the plant.

The leaching of calcined ores is performed by agitation in an acid electrolyte obtained as an effluent from the electrolytic zinc cells. The leaching of the acid roast fume calcine is performed by adding it to water or a neutral weak solution, obtained as wash-water, during suitable agitation provided by Pachucas or paddles. The zinc content of the primary solution obtained from the leaching is usually regulated to approximately 90 to 100 grammes of zinc per litre, this figure, however, is subject to variation, depending upon the rate at which the residue settles, the filterability, and the degree of solution purification required.

Leaching of Raw Arsenical Zinc Fume. The raw fume contains elements as oxides or oxygen-carrying compounds, which are, to a large extent, soluble in dilute sulphuric acid. The leaching of this material usually requires a different procedure common to general practice.

The fume that has been collected and stored as a mud contains arsenates of the metal due to the oxidation of the original arsenites previously mentioned. The principal arsenical compounds present during the leaching of this class of fume are the arsenate and the arsenite of zinc. The arsenate becomes a gelatinous translucent precipitate when the solution containing it is neutralized. This compound is difficult to filter and practically impossible to wash. A fume containing 2 or 3% arsenic as arsenate forms such a thick gelatinous mass upon neutralization in the leaching-vat that the agitation is

practically annulled and the tank content cannot be discharged through a pipe-line. Arsenites do not cause this condition.

In leaching the former class of fume, with dilute sulphuric acid, care must be exercised to the end that the pulp does not become neutral during this operation. Under certain conditions it becomes necessary to limit the amount of acid used for leaching because of an insufficient plant production of this reagent to balance the acid system. In this case sulphur di-oxide gas, 6 to 10% by volume, may be used to balance the acid deficiency. To carry out this method of leaching, the fume is slimed, delivered to an agitating-vat containing neutral solution, and the sulphurous gas delivered to cause a solution of the excess portion of the acid-consuming constituents. This procedure permits the completion of the leaching with the reduced available supply of sulphuric acid.

TABLE I

Changes occurring in the composition of acid-mixed fume during calcination in a Wedge roaster, 25 ft. diameter, seven hearths, of which six were heated.

	feed Roaster	hearth 2nd	hearth 3rd	hearth 4th	hearth 5th	hearth 6th	7th hearth, discharge
Sample	1	2	3	4	5	6	7
Hours in furnace	0	1	2	3	4	5	6
	%	%	%	%	%	%	%
Total Zn 18.00		18.20	18.8	19.4	19.7	19.8	19.8
Water Sol. Zn..15.97		17.36	17.8	18.4	18.6	18.6	18.6
Total Cu 1.08		1.15	1.18	1.20	1.22	1.22	1.22
Water Sol. Cu.. 0.03		0.23	0.40	0.55	0.67	0.75	0.79
Total Fe 6.93		6.98	7.20	7.35	7.54	7.58	7.60
Water Sol. Fe.. 0.60		0.68	0.80	1.12	0.80	0.50	0.20
Total As 8.0		7.8	6.0	5.5	5.0	4.6	3.5
Water Sol. As.. 3.0		3.0	2.0	1.0	0.5	0.2	0.01
Temperature C. ..		330°	385°	405°	410°	455°	510°

TABLE II

Solubility of pure SO_2 gas in zinc-sulphate solution at various temperatures. Sp. gr. of solution 1.22

°C.	Weight of SO_2 dissolved one litre SO_2 gas gm	in one litre of sol. gm.	SO_2 in solution %	Volume of SO_2 dissolved per litre of sol.
20	2.68	47.5	3.89	17.7
30	2.54	32.3	2.66	12.5
40	2.50	22.5	1.84	9.0
50	2.43	17.0	1.40	7.0
60	2.32	12.5	1.02	5.4
70	2.28	9.0	0.73	3.9
80	2.22	6.5	0.53	2.9

TABLE III

Separation of copper and sodium from zinc solutions by electrolysis

Area of cathode	8.59 sq. ft.
Area of anode	8.59 " "
Gallons electrolyte per square foot of cathode.....	2
Copper per litre of solution.....	5 grammes
Cadmium per litre of solution.....	0.5 "
Zinc per litre of solution.....	90.0 "
Current-density at start, per square foot.....	5.0 amperes
Current-density from 0 to 50% copper depletion.....	5 to 11
Current-density from 50 to 75% copper depletion.....	11 to 5
Current-density from 75 to 80% copper depletion.....	5 to 1.5
Current-density from 80 to 100% copper depletion.....	1.5 to 1.0
Average current-density over-all with respect to time....	4.5
Current-efficiency	82%
Loss of zinc per 100 lb. copper.....	1.0
Spacing of anode to cathode.....	1 5/16
Air agitation	
Average temperature	55°C.
Voltage	2.45

TABLE IV

Corrosion rates of cathode zinc, melted zinc, rolled zinc, rolled aluminum

Corroding solution { Zn 56 gm. L. / H_2SO_4 105 gm. L.

Area exposed 18 in. by 6 in.	Loss per sq. ft. per 24 hr.
Cathode zinc	0.3 lb.
Melted cathode zinc	12.0 "
Rolled sheet-zinc	10.0 "
Rolled aluminum	0.003 "

During this part of the leaching there is sufficient reduction of arsenate to arsenite to permit the addition of sulphuric acid to the pulp without the arsenate gelatinization of the mass in the vat. Without this incomplete reduction to arsenite, however, the addition of acid to the pulp induces an objectionable semi-solid condition of the pulp. It will be understood that the mere suspension of the fume in neutral solution does not cause gelatinization because no arsenates are dissovled until acid has been added.

Effectiveness of SO_2 in Zinc-Sulphate Solution. The solubilities of pure sulphur di-oxide in the zinc-sulphate solution at various temperatures are as follows (see Table II):

If the preliminary leaching is made by a 7% SO_2 gas,

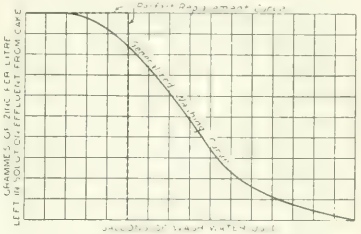


Fig. 1. General Washing Curve.

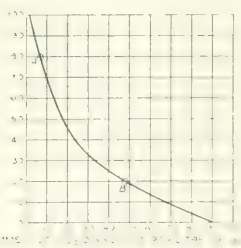


Fig. 2. Curve Showing Solubility of SO_2 in Zinc-Sulphate Solution Interpolated Beyond A. and B.

then the SO_2 present in the gas mixture can only exert 7% of the pressure, which permits a given volume of pure SO_2 being dissolved in one volume of solution at a given temperature. If the temperature of the solution absorbing the gas is 60°C., it will be seen, in Table II, that 5.4 volumes of SO_2 are dissolved in one volume of zinc-sulphate solution, if 100% SO_2 gas is used. The 7% SO_2 gas $\frac{7 \times 5.4}{100} = 0.378$ volume.

This is equivalent to 100 cc. solution dissolving 0.0378 litre SO_2 and the weight of this gas at 60°C. is $2.32 \times 0.0378 = 0.0876$ gm. If the weight of 100 cc. zinc-sulphate solution is 122 gm., the percentage of SO_2 in the solution amounts to $\frac{0.0876 \times 100}{0.122} = 0.071$ of 1%, or 0.87 gm. SO_2 per litre of solution. It will thus be seen that 0.071 or 0.87 gm. of SO_2 per litre is approximately the maximum of absorption when using 7% of SO_2 gas.

While this percentage of SO_2 dissolved is low, the re-

sults are materially augmented in the presence of sulphites or bi-sulphites of the heavier metals. Thus when SO_2 is combined with CaO or ZnO, it can be present to the extent of several percentages. In such cases the solution acts first as a carrier between the SO_2 and the heavy metallic bases, and second as a better solvent for the zinc salts by virtue of its newly acquired property.

Inasmuch as there are arsenates present in the pulp in suspension, there is a fairly rapid oxidation of the SO_2 to H_2SO_4, which dissolves more zinc and arsenic from the fume, and the continual presence of SO_2 prevents arsenates being formed in the solution. A solution of zinc as sulphite can be quite rapidly changed into the sulphate by the means of air agitation.

Filtration. The great irregularity in the filtering rates for different classes of materials in connection with the degree of filter-cake washing required and the disposition of the residual solids make the selection of a filter best suited for the work a matter of considerable circumspection.

Filtration of suspensions of calcine-residue is always performed where economically possible, on thickened pulp by a continuous vacuum type of filter. Some kinds of fume, however, do not settle well; in fact, under certain conditions no perceptible settlement occurs with this class of material. The filtration is usually performed by delivering the material in an unthickened condition to a pressure type of filter, whereby higher pressures can be applied than can be obtained in vacuum-filter. It is true generally that a suspension of solids that cannot be thickened has a slow filtering rate, and if this unthickened pulp were delivered to a continuous-vacuum filter, the cake formed would be extremely thin, and as such cannot be efficiently washed nor effectively discharged from the filter-cloth.

To maintain a workable condition of the cloth in a mechanical filter it is quite important that the cake formed be of sufficient thickness to possess a coherent property, so that it can be dislodged in mass from the cloth by air-pressure from within. The imprint of the cloth-fabric is present on the inner face of the cake when removed properly. The scrapers employed to remove the cake after it has been separated from the filter-cloth by air-pressure, cannot be used effectively to separate the cake from the cloth, inasmuch as this action forces the fine solid into the pores of the cloth, resulting in premature clogging of the filtering medium.

For obvious reasons, the washing of filter-cakes to remove soluble zinc salts cannot be done with perfect replacement by the wash-water. Such an operation would imply only the use of a volume of wash-water equal to the volume of the liquid entrained in the cake to accomplish the desired end. Perfect replacement, however, only occurs during the first part of the washing cycle, and soon becomes inoperative owing to the diffusion of weaker solution into the stronger liquid in the cake. The amount of soluble salt removed per unit-volume of wash-water then becomes approximately uniform for a short time, after the soluble salts are greatly reduced in the cake, then a relatively less amount of these salts is removed per unit-volume of wash-water.

By plotting the volumes of the wash-water used per unit of zinc dilution along the abscissa, and the zinc contents of the filter-effluents along the ordinate, the following curve results; a short horizontal line representing perfect replacement, then this is bent to an inclined position coinciding with diffusion, and later, after a certain amount of soluble salts has been removed, the inclined portion is bent back somewhat, again approaching the horizontal, coinciding with that part of the wash which requires an enormous quantity of wash-water to remove a small amount of soluble zinc. This is shown diagrammatically in Fig. 1. The extent of filter-cake washing in practice is limited to an amount which will cause only permissible dilution of solution, as there is no material concentration of liquid in other parts of the plant.

There are many substances that exert a retarding influence on the rate of filtration and on the rate of effective washing. It is the physical condition of these substances rather than the substances themselves that is responsible for this influence. Generally speaking, colloidal matter in the mixtures to be filtered exerts this retarding influence. It is known that most of the elements can be caused to exist in the colloidal state, in which condition the extremely minute particles of the solids in suspension in the liquid remain apparently in perfect equilibrium with reference to their positions in the liquid; the influence of gravity tending to cause the suspended particles to settle is less than the forces which maintain the perfect suspension. These forces also exert an effective resistance to the separation of the suspended solids from the liquid when filtration is attempted.

Among the principal substances that have a retarding influence on filtration and the washing of cakes are silica, ferrous and ferric iron, alumina, and the arsenates of metals. The problem of overcoming the effects of these or similar substances is one that must receive first attention.

The leaching of calcined ore producing a solution which is slightly acid, presents a mixture that can be easily filtered and washed. The precipitation of silica and iron from this filtrate, obtained as above, may be accomplished by the addition of a base such as powdered lime-rock or calcined ore in the presence of an oxidizing influence. When this is performed by the addition of calcined ore, the gelatinous silica and flocculent iron compound become mixed with the incompletely leached residue of this calcine. The filtration of these solids from the solution, which is now neutral, is done fairly easily, but the solids are quite voluminous and flocculent, and by virtue of this property, a large quantity of solution is entrained in the filter-cake, from which it is not only difficult to remove by washing, but the volume of weak solution resulting from this wash would be in excess of that which could be economically used in the solution system.

This filter-cake obtained from the filtration of the solution that has been treated a second time with calcine con-

taining a large amount of entrained water-soluble zinc together with the residual unleached zinc oxide of the residue, in addition to the gelatinous silica and flocculent iron compound, is given a heat-treatment at 150°C. to

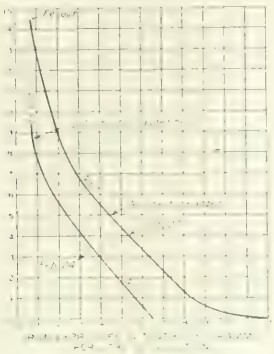


Fig. 3. Precipitation of Iron by Air-Bubbles Without the Use of Limestone. 400 Gal. of Solution.

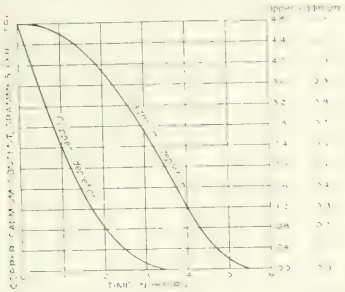


Fig. 4. Showing Relative Rates of Precipitation of Copper and Cadmium by Zinc Generalized.

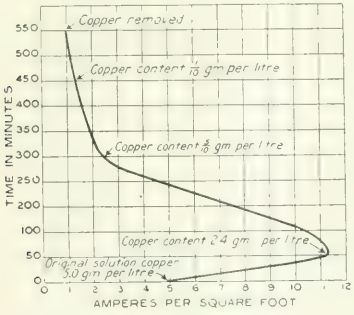

Copper removed
Copper content 1/10 gm per litre
Copper content 1/5 gm per litre
Copper content 2·4 gm. per litre
Original solution copper 5·0 gm per litre
TIME IN MINUTES
AMPERES PER SQUARE FOOT

Fig. 5. Curve Shows Maximum Amperes per Square Foot Available with 2.45 Volts when Precipitating Copper by Electrolysis in $ZnSO_4$ Solution. Practically no Precipitation of Zinc.

Cathode 23 in. wide, 27½ in. long
Anode 22 " " 26½ " "

dehydrate the silica and iron. This treatment renders these two substances insoluble in dilute sulphuric acid, which is used to dissolve the zinc compounds following the dehydrating operation.

There are other effective methods for separating the substances that have the deleterious effect of entraining soluble zinc salts in filter-cakes, and in all cases these methods have to be adapted to the particular class of ore and the local conditions. Some of them do not involve

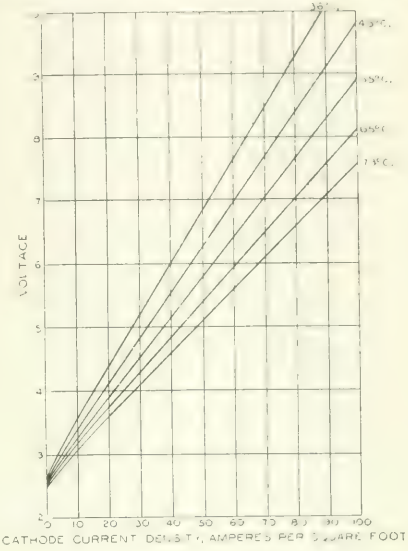


Fig. 6. Voltage-Current Characteristics

$ZnSO_4$ Sol., 107 gm./L Zn, neutral. Cathode-area, 5.0 sq. ft. Anode-area, 4.2 sq. ft. Anode-cathode spacing, 2 in.

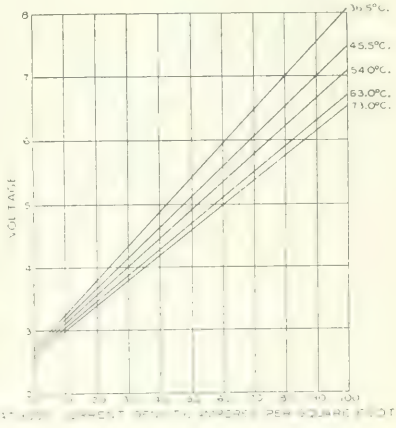


Fig. 7. Voltage-Current Characteristics.

$ZnSo_4$ Sol., 92 gm./L Zn, 22 gm./L H_2SO_4. Cathode-area, 5.0 sq. ft. Anode-area, 4.2 sq. ft. Anode-cathode spacing, 2 in.

heat-treatment for the separation of silica and iron from the soluble zinc.

The ores sent to the electrolytic zinc plant for treatment seldom contain soluble arsenic in excess of one-hundredth of the soluble zinc. The amount of arsenic

indicated by this ratio is too small to exert a serious effect on filtration or zinc recovery regardless of the form in which this element is present.

There are bag-house condensation products, however, that contain soluble arsenic to the extent of a quarter of the soluble zinc. When this class of raw fume is leached direct with dilute sulphuric acid, the treatment of this arsenical zinc solution presents a problem more complex than that presented in an electrolytic zinc plant treating ores. The arsenites of the metals in solution form a granular precipitate upon neutralization and therefore offer no serious filtration nor initial zinc-recovery problem. The arsenates, however, form a translucent jelly-like mass upon neutralization and would not only defeat the economic filtration but would change the entire contents of the leaching-vat to a gelatinous mass that would not flow through a pipe-line. Consequently, in the presence of considerable arsenate, the solution obtained in the leach must not become neutral and is filtered in the slightly acid condition such as 6 to 8 gm. H_2SO_4 per litre.

Removal of Iron From Zinc-Sulphate Solution. Some mention was made of the precipitation of iron in the foregoing paragraphs, but it was done only for the consideration of the inherent effect of the iron precipitate on the filtration of the residue. The precipitation of iron from zinc solutions will now be considered in a chemical sense.

It is a matter of common knowledge that iron cannot be completely precipitated by a base, such as zinc oxide, hydrated lime, or lime-rock, unless it is in the ferric state of oxidation. Practically all the soluble iron contained in solution obtained by leaching a roasted zinc-concentrate or fume is in the ferrous condition. When this solution is treated by a base without oxidation, the iron compound formed is not completely insoluble, and during subsequent filtering operations, part of this compound passes through the filtering medium, and part remains with the cake. The effective removal of the iron from the solution is therefore defeated by this treatment.

The oxidation of iron in neutral solution, when present in the usual amounts, namely, 0.1 to 3 gm. iron per litre, may be done economically by the use of oxidizing agents, such as manganese di-oxide, or other di-oxides when low in price, or by means of air agitation. The last is not effective if the solution is acid.

Manganese di-oxide is more rapid in its action than air agitation. The latter alone can be made to do the work effectively if the air-bubbles are in a fine state of division; if those bubbles are large, the oxidation of the iron is extremely slow, and therefore the operation is not performed economically.

Proper conditions for agitation by air are obtained by forcing compressed air into felt-covered boxes set above the bottom of the vat containing the solution to be treated. The vat used for this purpose has a conical bottom and is fitted with a Pachuca air-lift, to keep the entire contents in perfect suspension. The felt boxes set above the bottom of the vat suffer less interference from solid matter than would be the case if placed on the bottom.

The oxidation of iron by air is very greatly retarded if the solution has not been separated from the leached residue. This metal, if present in large amount, therefore, should be oxidized in solutions that have been filtered from the main leached residue, that is, if air alone is used for such oxidation.

The precipitation of iron is accomplished by the addition of the most economical base in presence of an oxidizing influence. The bases generally used are powdered lime-rock or calcine containing zinc oxide. The lime, falling to the bottom of the vat, is continuously elevated to the surface of the liquid by means of the Pachuca, which ensures effective circulation of the solution into the active oxidation zone caused by the passage of air through the felt boxes.

The complete precipitation of iron by powdered lime-rock in presence of minute air-bubbles is more economical when applied to a solution that is free from copper and cadmium. The precipitation of the iron following the removal of copper and cadmium from solution, implies a condition of operation seldom encountered in the treatment of roasted ore. The acid leaching of the latter yields a solution that must be subsequently neutralized by calcine, or by calcine in conjunction with a small amount of powdered lime-rock. This neutralization starts the precipitation of the iron, and having started, it should be completed at this stage of the work. Therefore in the treatment of ores, the iron is generally removed prior to copper and cadmium.

The water-leaching of fume that has been given an acid roast yields a solution of sulphates that is practically neutral with all the soluble metals in equilibrium, and therefore the order of removing the impurities from solution is guided by expedience. Under this condition the iron can be precipitated most advantageously by a non-zinky base, such as powdered lime-rock. The precipitation of iron with this reagent, instead of a zinc compound, renders the subsequent work simple, in that there is no material amount of residual zinc to recover. If a calcine containing zinc oxide were used for this purpose then an additional step of recovering the unleached oxide would have to be provided.

The precipitation of the iron in presence of two to six grammes of cadmium per litre in solution is accomplished slowly. The presence of cadmium in the above proportion retards the action between the powdered lime-rock and the solution to a considerable degree, necessitating the addition of a large amount of this reagent and prolonged air agitation to cause the precipitation of the iron. The operation under these conditions produces a large weight of precipitate, which carries a proportionally larger amount of entrained zinc as hydrate and sulphate.

Cadmium sulphate is not only irresponsive to powdered lime-rock, but it exerts an influence preventing the action of this reagent on other salts in solution; if it be present to the extent of 20 grammes per litre the action of the lime-rock as a purifier of the solution is nullified.

Copper does not have any marked effect on the precipitation of iron except to promote the consumption of a

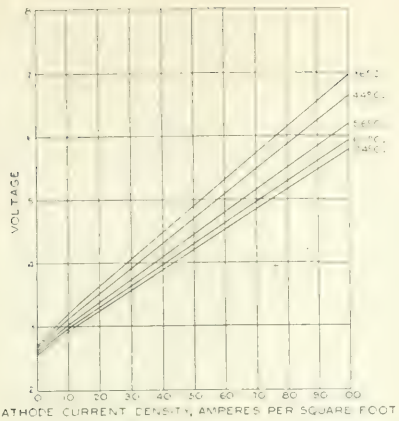


Fig. 8. Voltage-Current Characteristics.

$ZnSO_4$ Sol., 80 gm./L Zn, 41 gm./L H_2SO_4. Cathode-area, 5.0 sq. ft. Anode-area, 4.2 sq. ft. Anode-cathode spacing, 2 in.

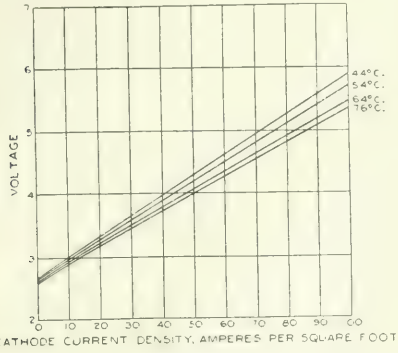


Fig. 9. Voltage-Current Characteristics.

$ZnSO_4$ Sol., 66 gm./L Zn, 61 gm./L H_2SO_4. Cathode-area, 5.0 sq. ft. Anode-area, 4.2 sq. ft. Anode-cathode spacing, 2 in.

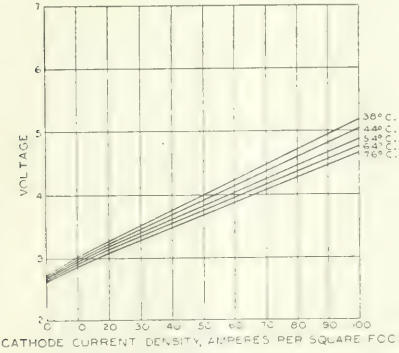


Fig. 10. Voltage-Current Characteristics.

$ZnSO_4$ Sol., 53 gm./L Zn, 81 gm./L H_2SO_4. Cathode-area, 5.0 sq. ft. Anode-area, 4.2 sq. ft. Anode-cathode spacing, 2 in.

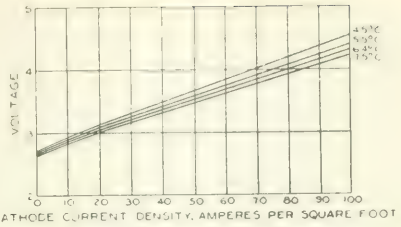


Fig. 11. Voltage-Current Characteristics.

$ZnSO_4$ Sol., 40 gm./L Zn, 101 gm./L H_2SO_4. Cathode-area, 5.0 sq. ft. Anode-area, 4.2 sq. ft. Anode-cathode spacing, 2 in.

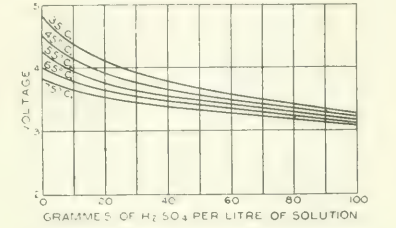


Fig. 12. Voltage-Acid Characteristic.

$ZnSO_4$ Sol., 107 gm./L Zn, neutral. Cathode-area, 5.0 sq. ft. Anode-area, 4.2 sq. ft. Anode-cathode spacing, 2 in.

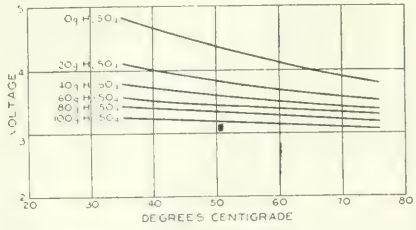


Fig. 13. Voltage Temperature Characteristics, $ZnSO_4$ Solution 107 gm./L Zn (Neutral). 25 Amperes per Square Foot.

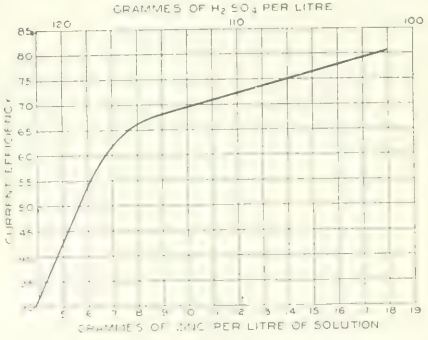


Fig. 14. Curve Showing Current-Efficiencies for Solution Containing Small Amount of Zinc.

larger amount of the lime-rock used in precipitating a part of the copper, and thereby increasing the weight of precipitate and the incidental loss of zinc. The removal of soluble iron from a solution that is free from copper and cadmium is accomplished by the addition of a small amount of powdered lime-rock, in a short period of air agitation. For example, a solution containing two grammes of ferrous iron per litre in the presence of six grammes of copper and five grammes of cadmium per litre occasions the use of approximately 80 lb. of powdered lime-rock per 1000 gal. and requires about eight hours of agitation, whereas a solution of the same iron content and free from copper and cadmium will only require 10 to 16 pounds of the lime-rock per 1000 gal. of solution and require from one to two hours.

The area of felt to be used for producing minute air-bubbles will amount to 20 sq. ft. per 16,000 gal. of solution. The weight of the dry solid in the precipitate usually amounts to 1.7 times the weight of the lime-rock used.

It has been proved that iron can be precipitated in a zinc solution free from copper and cadmium by small-bubble agitation without the use of powdered lime-rock or any other base. Curves showing the rate of iron precipitation for these experiments are shown in Fig. 3. Four hundred gallons of solution were used for each experiment. Curve No. 1 shows the results obtained without the addition of powdered lime-rock until the ninth hour of agitation, when half-pound was added. This caused the complete precipitation of the iron. Curve No. 2 shows that 14½ hours of agitation with air removed the iron, without the addition of lime-rock. There is a certain amount of zinc precipitated along with the iron, and both metals as precipitated were in the form of basic sulphates. This fact has an important bearing on the removal of iron from solution and although it would be impracticable to carry this out on a large scale, under certain conditions this method of operation may be available in part.

It is to be understood that the phrase "complete precipitation of iron" will be liberally interpreted, as there is a trace of iron present in all metallurgical solutions subjected to treatment for its precipitation.

Copper-Cadmium Precipitation. It is a matter of common knowledge that copper and cadmium are galvanically precipitated from solutions by means of metallic zinc. Zinc-dust, made by a blast of air through a stream of molten zinc, is the most satisfactory form of this metal for use in the precipitation of the above metals, under usual conditions. The method of application consists in circulating the impure solution and a proper quantity of zinc-dust through a Pachuca air-lift placed in a cone-bottomed tank. This simple method is quite effective, and causes a rapid precipitation of copper.

Cadmium, on the other hand, is not so rapidly precipitated and there is a slight re-solution of the compound precipitated. These facts make the complete removal of cadmium a difficult operation unless special precautions are taken. The difficulty varies with the amount of cadmium present. The zinc ores that are usually treated in an electrolytic plant seldom contain more than a trace of cadmium, and therefore the problem of removing it from solution is a minor one, and no additional step in the process is necessary. Bag-house products, on the other hand, are likely to contain a notable quantity of this metal. The treatment of these products in an electrolytic plant is planned in order to avoid the difficulty, the discussion of which follows:

A slight re-solution of cadmium takes place when a mixture of the copper and cadmium precipitates remain in contact with the zinc solution from which they were precipitated. This re-solution also occurs during filtration of the precipitated metals, unless the filter-cloths have been washed free from solids collected during a previous cycle.

The immediate filtration of a purified solution containing precipitated metals in suspension occasionally gives a filtrate sufficiently low in cadmium to send to the electrolytic cells. This simple procedure cannot be depended upon to give consistent purity of solution because of the uncertainties inherent in any method dependent upon operations that are restricted to narrow limits. The solution containing three or four grammes of cadmium per litre is given two treatments with zinc; the first one precipitates practically all the cadmium, which is separated from the solution by filtration, while the second zinc treatment precipitates the re-dissolved metal from a solution that is nearly pure. The solution containing a small amount of cadmium in suspension from the second treatment is immediately pumped through a clarifying filter-press, the effluent flowing to the cell-room.

A comparison of the rates of precipitation of copper and cadmium is shown in Fig. 4. Copper is precipitated quite rapidly from the start; a retardation in the rate is observed as the metal approaches depletion. Cadmium is precipitated slowly at the start, then gains a rate nearly equal to the copper precipitation. The general results show that the cadmium lags behind the copper in this work.

Separation of Copper and Cadmium From Zinc Solutions. Electrolytic removal of copper and cadmium from the zinc solution is not of commercial importance at the present time, but it may receive attention under changed conditions. In 1914 some work in this direction was done: the copper and cadmium were removed at a voltage that would not cause precipitation of the zinc.

The experimental work was performed in a cell containing two anodes and one cathode. The cathode was made of sheet-lead, 23 in. wide and 27½ in. long. The anode was of the multiple-pipe type, and consisted of a horizontal pipe from which fourteen half-inch lead pipes descended into the solution. The quarter-inch pipes form the active part of the anode, as well as provide uniform air agitation in the cell. A complete description of this anode will be found in my patent No. C 1,241,967 on electrolytic apparatus.

The great difficulty of this operation is to maintain sufficient conductivity of solution to avoid extreme low-

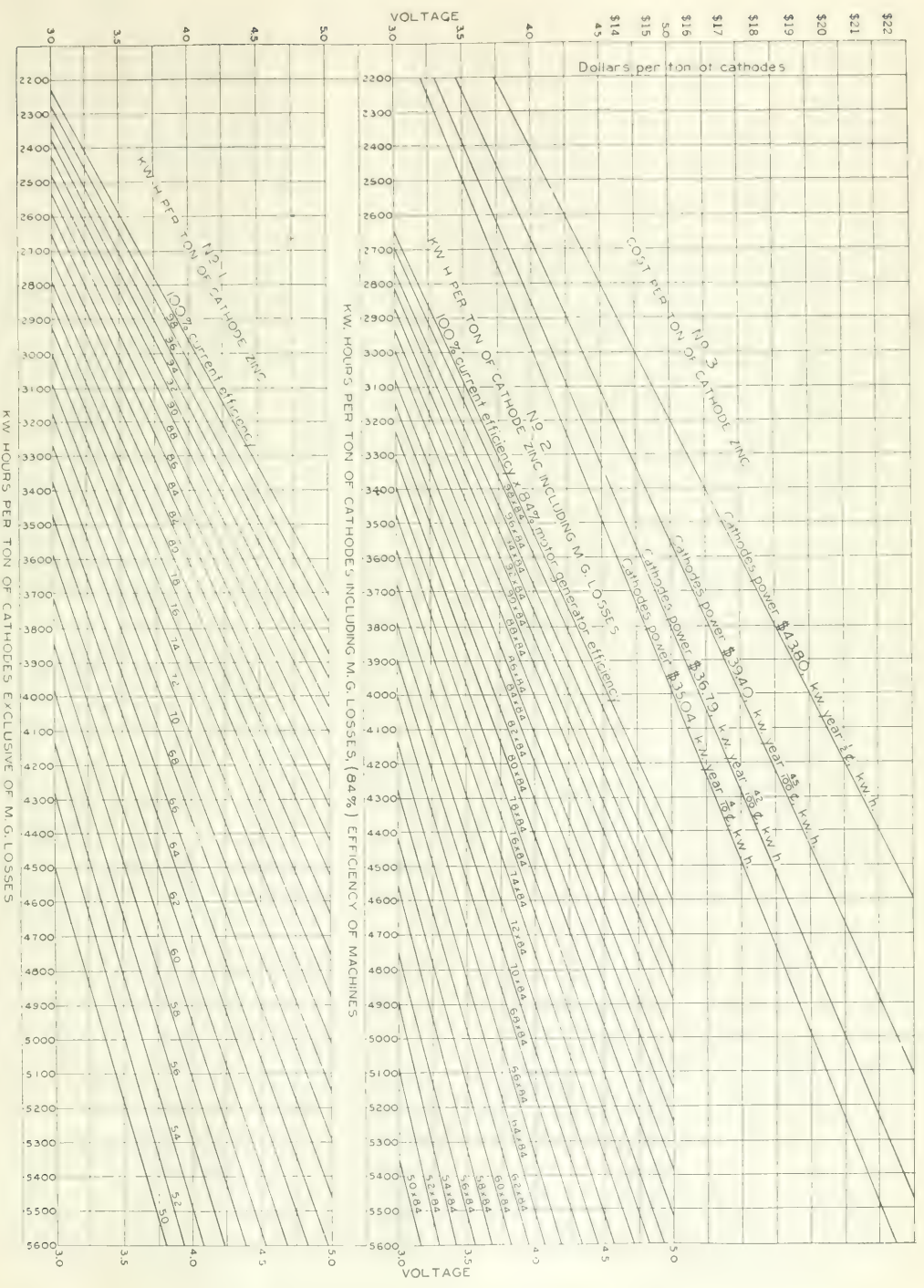

VOLTAGE
Dollars per ton of cathodes
$14
$15
$16
$17
$18
$19
$20
$21
$22
COST PER TON OF CATHODE ZINC
No 3
No 2
KW H PER TON OF CATHODE ZINC INCLUDING M.G. LOSSES
100% current efficiency (84% motor generator efficiency)
Cathodes power $43.80 KW year 1¢ KW h
Cathodes power $39.40 KW year 1.09¢ KW h
Cathodes power $36.79 KW year 1.19¢ KW h
Cathodes power $35.04 KW year 1.25¢ KW h
KW H PER TON OF CATHODE ZINC
No 1
100% current efficiency
KW. HOURS PER TON OF CATHODES INCLUDING M.G. LOSSES, (84%) EFFICIENCY OF MACHINES
KW HOURS PER TON OF CATHODES EXCLUSIVE OF M.G. LOSSES
VOLTAGE

Fig. 15. Curves Showing KW.H. for Various Current Efficiencies and Voltages. Also Power Cost per Ton Cathode.

current densities. The conductivity of a solution containing

Zinc	90	gm per litre
Copper	5	" " "
Cadmium	0.5	" " "

increases rapidly from the start until approximately 50% of the copper is precipitated, when it falls with equal rapidity until about 90% of this metal is removed from solution; then there is only a very gradual reduction of the low conductivity of the solution until the copper is finally precipitated. Note: the cell was operated as an accumulating acid-cell, without feed or overflow. The curves shown in Fig. 5 represent the current-density with reference to time and copper. The copper deposit is coherent until it has been depleted to 50 or 60%, when it becomes spongy and contains some copper oxide. The oxide is soluble in dilute sulphuric acid, which accounts for the vacillating action near the end of the electrolysis.

The expense involved in erecting and operating this type of plant would not be justified when compared with the more simple methods of copper-cadmium precipitation; the apparent lower cost of electric power compared with zinc-dust would be annulled by complicated operations.

Zinc Electrolysis. Considerable study has been given to the electrolytic deposition of zinc during the past seven years, and it has led to the recognition of sundry essential operating characteristics. Cathode zinc made from properly purified solution resists the attack of dilute sulphuric acid to a very great extent. This acid-resisting property of the deposited metal is one of the fundamental requisites, otherwise the economic application of electrolysis to zinc solutions would be defeated. After cathode zinc has been melted and solidified it becomes readily soluble in dilute sulphuric acid. Electrolytic zinc deposition is confined to solutions high in acid, namely, 50 to 90 gm. of H_2SO_4 per litre; therefore the acid-resisting property of the zinc is essential. If this were not the case this metallic deposit would be dissolved at a prohibitive rate.

A general idea of the corrosion of cathode zinc, melted cathode zinc (iron or graphite pots), rolled zinc, and rolled aluminum may be seen in Table IV.

Current, Voltage, Temperature. The drop in the electro-motive force (E. M. F.) of an electrolytic-zinc cell, for a current that is practically zero, is approximately 2.6 volts at the ordinary room temperature. The aproximate average voltage for economic operation is 3.6. It will be seen then that about 72% of the E. M. F. is represented by electro-chemical resistance and 18% by ohmic resistance. With a given current-density, the acidity of the electrolyte has the greatest influence upon the voltage of a cell.

The temperature of the electrolyte has only a moderate influence upon the voltage. The rise of temperature in electrolytes that are nearly neutral will cause a much greater percentage reduction in the voltage than for highly acid solutions. The voltage, current, temperature, characteristics for electrolytes between neutrality and 101 gm. of acid per litre, from 36°C. to 73°C., and from zero to 100 amperes per square foot are shown on Fig. 6, 7, 8, 9, 10, and 11. Fig. 12 shows the influence of the acid upon the voltage for various temperatures at 25 amperes per square foot. Fig. 13 shows the influence of temperature upon the voltage for 25 amperes. The experimental work for the collection of these data was extended over sufficient time to ensure constant conditions in each test.

For regular operations the current density is usually controlled between 25 and 30 amperes per square foot, the acidity between the limits of 30 and 100 gm. per litre, the average voltage is usually 3.6, and the cell-electrolyte is cooled by water-pipes to 30 or 40°C. Unless cooling water-coils are placed in the cells the temperature will rise above 60°C., when the cathode zinc is energetically attacked by the acid electrolyte.

Current-Efficiency. In electrolytic zinc work the efficiency of the current is very close to the difference between the theoretical ampere yield and the losses sustained by chemical corrosion. The over-all current-efficiency in cell plants that operate on properly purified solution, the overflow of which contains about 20 gm. zinc per litre and 96 gm. acid per litre should be approximately 80%. The electrolyte becomes more corrosive to cathode zinc as the zinc content of the solution becomes less than 20 gm. per litre.

The curve shown in Fig. 14 represents the ampere efficiency in depositing zinc from attenuated zinc-sulphate solution under good conditions. There is a decided break in the efficiency when the zinc in solution is depleted below 10 gm. per litre, after which there is nearly a horizontal decrease in efficiency as the metallic content approaches exhaustion.

The solution containing 20 gm. Zn/L also contained 100 gm. H_2SO_4/L, while the solution containing 5 gm. Zn/L contained 121 gm. H_2SO_4/L. It is readily seen that operation much below 20 zinc/litre is not economical.

Kilowatt-Hours. The curves shown in Fig. 15 may be useful in quickly determining the kilowatt-hours per ton of cathode without calculation. These curves cover the range of current-efficiency from 100% to 50% and at E. M. F. values between 3 and 5 volts. The lower set of curves show kw-hours per ton of cathode without reference to motor-generator efficiency. The middle set shows the kw-hours per ton including an 84% motor-generator efficiency. The upper set of curves shows the cost per ton of cathode for various power-rates (all line losses and transformer losses being excluded).

Example: assume voltage at 3.6, current-efficiency at 82, power-cost at 0.45 cent per kw-hour. The lower set of curves opposite 3.6 volts intersects the incline at 82% on 3200 kw-hour value. The middle set opposite 3.6 volts intersects the incline at 0.84×0.82 vertically above 3850 kw-hours. The vertical extended upward from 3850 cuts the incline cost-curves of 0.45 kw-hour at a point that, when extended over to the left margin of the paper, indicates $17.30 per ton of cathode for power.

Milling Practice at the Benguet Consolidated Mine—I

Historic Notes and Development of Methods

By C. M. Eye and M. F. Dodd

The first milling of ores from this mine, situated in the Benguet district of the Philippine Islands, was in a small plant ordered in 1905, and placed in operation late in the following year. This, the first plant in the Islands to include cyanidation as a part of the treatment, consisted essentially of the following equipment: One 7 by 10-in. rock-breaker, one Hendy three-stamp individual mortar in a quadruple-discharge battery, with apron and table plates for outside amalgamation, one bucket-and-belt elevator, one upward-current inverted-pyramid type of wooden classifier (made on the ground), a Butters & Mein distributor, six Oregon pine leaching-vats, each of 50 tons sand capacity, the usual vats for strong and weak solutions, zinc-boxes of the individual bucket type, one centrifugal pump for returning solutions, and a four-foot Pelton water-wheel, from which the whole plant was driven. It was what may be termed a ready-made plant of the simplest description.

The treatment as first practised was equally simple: Crushing to two-inch maximum, reduction in water in the battery through a diagonal-slot screen with openings corresponding to 24-mesh, passage of the pulp over the amalgamating tables and through a trap at the foot, thence elevating about 25 ft. and discharging into the classifier, running the overflow to waste and the underflow to the distributor (by means of which the vats were in succession charged with sand), treatment by leaching for 10 days or more, followed by solution and water washes, and final sluicing out. It would be a waste of time and space to describe in further detail the treatment that followed, as it was the familiar round in use at the time in most of the small cyanide plants of the world. The fact that owing to scarcity of lime, caustic soda was used for counteracting acidity, may be worth mentioning. Another reason for this was that when lime was fed to the battery, gypsum was formed by combination with the sulphates in the ore, clogging the screens and building up on any exposed iron or steel surface. Caustic soda was easily obtained in the Manila market, at a reasonable figure, and proved fairly satisfactory, except that whenever the alkalinity became low in the leaching treatment, gelatinous precipitates of iron and aluminous hydrates would form and enter the extractors, thereby causing much trouble. Later on, when lime became plentiful, it was substituted for caustic soda, being added mostly in the treatment-vats, after amalgamation and classification.

The initial recovery made by this plant, working on fairly well oxidized ores from near the surface, was poor, but even at that it was better than anything that had been done in the Islands up to that time. About one-third of the gold was caught by amalgamation, and of the gold in the sand about 70% was recovered by leaching. It soon developed, however, that the slime overflowing the classifier, and amounting to nearly 40% of the ore, was of better grade than the sand (even at times exceeding in value per ton the original ore). This naturally led to the introduction of slime treatment, with an attempt, in the meantime, to impound the slime until the necessary equipment could be provided. This effort was unsuccessful, because the climate and topography were unfavorable, but a plant consisting of a pair of vats with stirring mechanisms that could be raised and lowered was put into operation as soon as possible, and gave very satisfactory results in spite of its small capacity. The vats were alternately charged, settled, and decanted, solution added, charge agitated from 12 to 14 hours, settled, solution decanted to precipitation, fresh solution added, charge stirred and allowed to settle, solution decanted, and so forth, there being from three to four additions of solution followed by one of wash-water and final discharge through a door at the bottom. This represented a round of treatment quite fashionable at the time. It is to be noted that no fresh cyanide was used in the slime treatment, the strength of the solution from the weak circuit of the mill, containing about 1½ pounds of cyanide per ton, being sufficient. The recovery was from 80% to 90% of the gold in the slime, which added materially to the percentage recovery of the plant. The principal difficulty arose from the slow settling of the pulp, and low final density, thus limiting the capacity and holding back the rest of the operations. In the meantime, better precipitation facilities had been furnished by building regular double-line compartment wooden zinc-boxes, using imported redwood. The buildings, at first covered by grass thatch, were roofed with galvanized corrugated iron.

Concentration experiments on the material leaving the plates, and on the treated sand, yielded a product of about $100 per ton from the former, and of about $30 from the latter. These results led to the addition of a Wilfley table over which the classified sand passed on the way to the leaching-vats. By this means, a small amount of high-grade concentrate was recovered, the recovery in the leachers improved, and the time of treatment shortened. The concentrate was stored and shipped to the Selby smelter, at San Francisco, for treatment. It assayed somewhat over $100 per ton, and contained some amalgam and quicksilver that had escaped the trap. An

incomplete recovery of these was made later by passing the stream of concentrate through a riffled launder over amalgamated plates.

The plant, as thus constituted, worked steadily for several years. A second battery of three stamps, identical with the first, was added in 1908, but, owing to lack of capacity in the cyanide plant, was operated mainly on old stope-filling and other fairly well oxidized material, inexpensively mined, and yielding more than 50% by amalgamation only. The average grade of ore sent to the first battery was from $16 to $18 per ton, and of that to the second, from $8 to $10. It is apparent that the loss in the tailing from the mill was high, but in view of the situation and limitations of the enterprise, working 'on a shoe-string' and necessarily self-supporting, the results, bad as they were, kept things going and yielded a profit. The major portion of the ore treated was from development, and the mill served a useful purpose in furnishing data on the proper metallurgical practice. Its destruction by flood in 1910, while apparently a great calamity, and indeed a sad and serious affair to those interested, was probably a blessing in disguise.

With a view to increasing the capacity and saving of the mill, a Ridgeway filter of the 'spider' type, with accessory apparatus, was purchased, but it had just been put into operation when the flood occurred. Therefore no data on vacuum filtration were obtained that would serve in planning for future work beyond demonstrating that a cake of satisfactory thickness and dryness could be made. The filter worked smoothly during the extremely short time it was in operation, and probably would have justified its use by increased output and saving. It was fed from a receiving-vat above, of the same capacity as one agitator-vat, the agitators discharging alternately into this after several decantations of solution. After continued settling, additional solution was removed by decantation from this receiving-vat.

The flood destroyed most of the cyanide plant, but left the stamps and plates and water-wheel. During 1911 and 1912 these were operated fairly steadily on an accumulation of low-grade dump-material that had become partly oxidized, and therefore yielded fairly well to amalgamation. Mixed with this was more or less old stope-filling (from primitive workings near the surface) and a certain amount of high-grade ore stoped from the mine and added as 'sweetening'. This period was ended by a second flood in the fall of 1912, which not only removed the remainder of the plant, but the site as well. In 1914 the property was re-financed, plans were made for building a new plant (after experimentation in the States, conducted on a shipment of ore), and the work of erection started late in that year, on an entirely new site, well above, and protected from, the stream. This plant, to be operated by a hydro-electric plant, included in the plans for rehabilitation, was designed to treat 60 tons per day by fine grinding and cyaniding, without amalgamation. It included the following equipment: One Hercules Blake rock-breaker, 8 by 12 in., preceded by a grizzley, 3 by 8 ft.; one ore-bin of 100 tons capacity, carrying the grizzley and breaker, and preceding the stamps; two suspended Challenge feeders; one unit of 10 stamps of 1050 lb. each, with two single-discharge mortars, set on concrete blocks; one tube-mill, 6 by 10 ft.; one Dorr duplex classifier; one belt-and-bucket elevator; one 10 by 8 in. two-cylinder single-acting vertical air-compressor; one 6 by 8 in. horizontal wet-vacuum pump; two 4 by 6 in. Goulds all-iron triplex pumps; one steel clarifying-vat with 18 canvas leaves, each about 5.5 by 8 ft.; three steel zinc-boxes of two lines of seven (2-ft. square) compartments each; full equipment of vats for continuous counter-current decantation, comprising one primary, and four secondary thickeners with tanks 25 by 12 ft., three Dorr agitators with tanks 14 by 10 ft., one sump-tank, 12 by 10 ft., and one storage-tank 25 by 12 ft. (all of corrugated galvanized steel), and one Goulds No. 4 diaphragm-pump for each thickener except the last of the series; one wooden tank, 5 by 5 ft., fitted with a nozzle-outlet and a Bristol recording gauge; one automatic-tipping tailing-sampler, one Hampton improved zinc-lathe; one emery-wheel; and a clean-up and melting equipment consisting of one small wooden receiving-vat, one small vacuum-tank, drying-pans, etc., and one No. 125 Case melting-furnace. The crusher was driven by belt from a 10-hp. motor; the stamps, all on one shaft, from a 25-hp. back-geared motor; the tube-mill by belt and friction-clutch pulley from one of 50 hp. (with the elevator and classifier on a shaft driven by quarter-turn belt from the counter-shaft of the tube-mill), the compressor driven direct by belt from a 15-hp. motor; the primary thickener, agitators, wet-vacuum pump, zinc-lathe, emery-wheel, and triplex pumps all from another motor of 15 hp.; and the secondary thickeners with their diaphragm-pumps from one of 3 hp. The entire plant was roofed with corrugated galvanized iron, and the reduction, precipitation, and refining departments enclosed in plain galvanized iron, the rest being left unenclosed. The galvanized corrugated vats (the bottoms of which were of smooth galvanized steel) were all riveted, soldered, and carefully painted. This plant began operations in September 1915, and, with the additions and alterations herein noted, has been in steady operation ever since.

The plan of operation was as follows: The ore, brought from the mine through a new cross-cut, was dumped, without weighing or sampling, over the grizzley, the oversize going through the rock-breaker, set to a two-inch opening, thence dropping into the 100-ton bin back of the stamps. From the bin it passed to the feeders through chutes with regulating wooden gates, thence to the stamps, the stock cyanide solution being added in the battery in the proportion of 5:1. Rectangular steel screens of from one-eighth to one-fourth inch net width of opening were used, the coarseness being varied to balance the work of the stamps and the tube-mill as nearly as possible. (Experience soon showed that a considerably coarser screen could be used to advantage.) The pulp was carried from the stamps by launder to the Dorr classifier, in closed circuit with the tube-mill, wherein grinding was carried

to minus 100-mesh. The pulp, with about 6:1 dilution, was elevated and discharged into the primary thickener, the overflow from which went to precipitation after clarification, while the underflow, lifted a few feet by the diaphragm-pump, entered the first of the three agitators, thence through the second to the third, and thence to the first of the secondary thickeners, the overflow of which was returned by one of the triplex pumps to storage. The pulp passed progressively through the secondary thickeners, meeting in the first three the counter-current of wash solution, and in the last, a water-wash. The barren solution from precipitation, handled by the second triplex pump, joined the pulp as it went to the third of the secondary thickeners, being augmented in volume by the overflow from the last thickener. After sampling, the stream of pulp was run to waste.

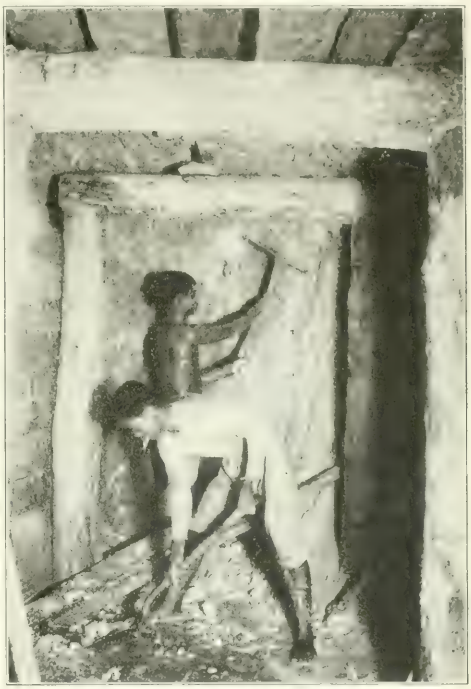
A continuous record of the flow through the zinc-boxes was obtained by means of the small receiving-vat and Bristol gauge, the latter recording the head at all times during the day on the centre of the discharge-nozzle. From this was figured the average head for the day, and by using a chart showing the flow for various heads through the nozzle in use, the total tonnage passing was easily and accurately determined. Frequent pulp and solution samples were taken throughout the mill, the tonnage of ore treated being calculated, with occasional weighing of cars as a rough check.

At first the cyanide strength in the agitators was maintained at about 1½ lb. per ton of solution, by the addition of cyanide to the pulp as it entered the series, but it was found soon that this strength could be reduced to one pound or less, with equally good results and lower cyanide consumption, and that the best point to add fresh cyanide was at the head of the tube-mill, in which, owing to the working in closed circuit with the classifier, a concentration of the precious metals occurred; by maintaining the cyanide strength at from 1.5 to 1.8 lb. at the discharge end of the mill, a very effective selective treatment of the sulphide and other heavier and higher grade constituents of the ore was obtained, while the strength of solution from this point onward was sufficient without further additions of cyanide, to secure maximum dissolving and ensure good precipitation.

Lime for maintaining protective alkalinity was at first scattered by hand on the dry ore going to the feeders, but this method proving unsatisfactory, a mixer of the Chilean mill type was built on the ground, and installed above the battery-floor. From it a thick emulsion of lime in cyanide solution is fed to the batteries, the quantity of lime being regulated by the flow of cyanide solution.

In order to reduce the loss of dissolved metal and of cyanide in the tailing, as well as to increase the time of contact with the cyanide solution, a Trent replacer was installed below the last thickener of the series. The stream of barren solution was then added to the pulp as it entered the last thickener, and the underflow from this thickener, going to the replacer before being discharged, received therein a wash by replacement with water. This change reduced the tailing loss.

In the reduction end of the plant, the need was soon felt for preliminary classification in advance of the Dorr classifier, to relieve it of handling such a range of product, by removing the bulk of solution with the lighter slime, and, as coarser battery-screens were used, of the coarser portion direct for tube-milling. Upward-current pyramidal classifiers, using cyanide solution, were first tried for slime elimination, but proved rather unsatisfactory on account of excessive dilution and difficulty of regulation, and a drag-classifier of the Esperanza type, built on the ground (as were the pyramid classifiers) was installed to accomplish the second result. The changes made later and herein described relegated the upward-current classifiers to the scrap-heap, by providing sufficient capacity in mechanical classification.



NATIVES AT WORK UNDERGROUND

The plant was originally designed to handle 60 tons per day; it was soon shown in practice that this could easily be exceeded in the reduction end, but the capacity of the treatment plant was less, owing to the high grade of the material, the slow settling of the slime, and the protracted dissolving of a portion of the precious metals. In order to secure greater capacity with longer contact and better results, a second line of treatment-vats was added. This series consisted of a 30-ft. Dorr thickener, supplied by a belt-and-bucket elevator and served by a No. 4 Goulds diaphragm-pump; a 25 by 18 ft. Trent agitator with 5-in. centrifugal slime-pump, and two Trent replacers, each 24 ft. in diameter at the top, 20 ft.

at the bottom, and 14 ft. deep, with 4-in. centrifugal circulating pumps. One 6 by 8-in. Goulds triplex pump and an additional sump and storage-vat were added. Three more double-line zinc-boxes more than doubled the precipitation capacity, while the facilities for handling the product had previously been increased by the installation of a filter-press, served by a rotary pump. In the refinery the furnace equipment was duplicated and a laboratory crusher, grinder, and baby Wilfley table added to reduce and concentrate the slag.

It was planned to use the new series in parallel with the old, with the old replacer in common, for washing, either by splitting the pulp between them in the proportion of their demonstrated relative capacities, or by giving to each the product best suited to it. Practice soon demonstrated, however, that better results could be obtained by working the various units in series, as shown in the flow-sheet of the present practice. It would have been interesting to have been able to obtain, over long periods, comparative figures on the working of counter-current and replacement, working side by side in the same plant, had economic conditions permitted.

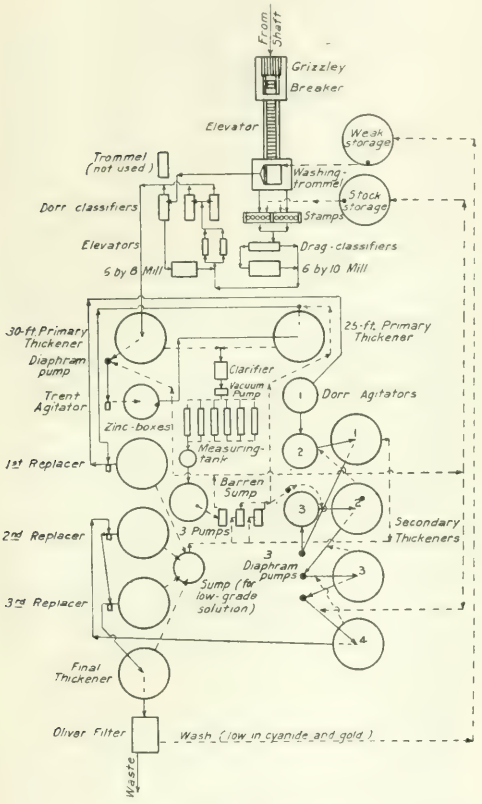
The final addition to the treatment, made in 1919, consisted of an Oliver filter, 12 ft. diam. by 18 ft. long, with the usual accessory apparatus, and a 25-ft. Dorr thickener in advance of the filter. These additions brought the capacity of the treatment plant up to a point where further additions and improvements were needed at the reduction end, so, last year, another tube-mill, 6 by 8 ft., was added, together with a washing, screening, and classifying system, whereby the coarse ore was separated from the fine previous to stamping, the slime carried directly to treatment, and the work of classification much facilitated and improved. The units comprising it are described in the summary of present practice, which follows:

The ore is a mixture of quartz, iron oxide, and sulphide, altered diorite, and clay; quartz predominates over the other gangue-minerals, and the iron sulphide now greatly exceeds the oxide in quantity. There is some free gold, but none is visible. Some of the sulphide may be of primary origin, but it is likely that the greater part of it is secondary, even though much of the ore appears to be unaltered. The kaolinization apparent in much of the ore is evidence of strong secondary action. The clay in the ore comes mostly, however, from the gouge on the walls of the vein. Most of this is discarded in mining, but in places it is highly mineralized, and in others mining conditions makes it impossible to eliminate it. The partly altered diorite, considerably silicified, alongside the ore-shoots, is often sufficiently mineralized with gold-bearing pyrite to warrant its inclusion with the run of mine. Some silver is associated with the gold, the bullion returns showing a recovery of about 1:3 by weight. The ore shows slight traces of copper at times, and possibly of lead, the former as a silicate or carbonate and the latter as galena, but not enough to affect the treatment in any way. The supply of ore now comes entirely from the levels below the mill-level, through a vertical shaft, directly back of the mill. It is weighed underground, hoisted, and dumped on a grizzley, 8 ft. long by 7.5 ft. wide, set at an angle of 50° from the horizontal, over a receiving-bin, which also carries the rock-breaker, moved back to this position. The combined product from the grizzley and breaker is fed by a reciprocating plunger-feeder from the bin to an inclined elevator, of the close-connected bucket type, which lifts it about 25 ft. and discharges it into a revolving trommel 4 ft. in diameter by 6.5 ft. long, set at an inclination of 1.5 in. per foot, and driven by bevel gear. Spray-pipes near the top on each side furnish weak solution for washing the fine and clay from the coarse. The oversize, well-drained and quite free from clay except such chunks as ball up, falls directly from the washer into the bin behind the stamps, and thence is fed through the chutes and feeders into the batteries. The product that passes the screen of the trommel drops directly to a Dorr duplex classifier, one of a battery of three, set sufficiently high to allow the slime to overflow by gravity to the primary thickeners. The one classifier first mentioned, however, is set higher than the other two, in order to enable the overflow to be divided between the other two if desired. It is to be noted that a second trommel, of dimensions smaller than the one mentioned, and furnished with a finer screen, was included in the system, with the idea of providing a direct tube-mill product by screening, but this is not being used, the classifiers evidently accomplishing the work sufficiently well. It is also to be noted that lime is added at the washer in an emulsion supplied by a mixer identical in construction with the one already mentioned in connection with stamping. The screen covering of the trommel is of punched sheet-steel, with elliptical holes, 0.25 by 0.75 in. (the original plan contemplated using screens of five-eighths inch net openings on this trommel and of five-sixteenths on the second one).

The discharge from the stamps, through screens having openings ranging from 0.5 to 0.75 inch, goes to the drag-classifier, which sends a coarse product to the head of the longer tube-mill, while the slime-overflow joins the discharge from this mill, to be elevated and divided between the two secondary Dorr classifiers, or delivered to either of them. (One of these classifiers is the one formerly used in closed circuit with the 10-ft. mill, but moved up.) The coarse product of the primary Duplex classifier, mentioned as receiving the undersize from the trommel, goes by gravity to the head of the shorter tube-mill, the discharge from which flows to the foot of another elevator, delivering to either or both of the secondary classifiers. The arrangement of the elevators is such that either can receive the flow from either or both mills and from the drag-classifier overflow, and discharge to either or both of the secondary classifiers, the head product of which can go by gravity to either or both of the tube-mills, thus constituting an elastic system in closed circuit.

The combined overflow from the classifiers is carried by gravity to the 30-ft. thickener, from which a clear

overflow of pregnant solution is taken for precipitation after further clarification, while the pulp, thickened to 1.25 : 1 is drawn and lifted to a launder from which after dilution to 2 : 1, with fresh barren solution, delivery is made to the Trent agitator through the suction of the 5-in. circulating pump of that machine, the suction-pipe being carried vertically alongside the tank, and to the level of the top. Thus the static head is utilized, and a



FLOW-SHEET OF MILL

mixture of atmospheric air, essential to the operation, is drawn in with the pulp. The suction stand-pipe is connected by a branch through the side of the tank, about two feet from the top, whereby pulp from the charge is drawn into it, mixing intimately in the stand-pipe and pump with the incoming pulp and air. Delivery is made from the pump through the bottom of the vat to the distributing arms and mechanism. The volume thus circulated every hour is approximately equal to the volume of the contents of the vat, while the volume entering is about one-twentieth of this, thus securing about 20 complete circuits of the tank before passing on to the 25-ft. primary thickener. (If more air is desired in the agitation, it is admitted through a pet-cock in the pump-suction.) The discharge from the agitator is through an open pipe through the side of the vat at six inches from the top, no additional solution being added before it reaches the thickener, unless more is required to furnish the desired amount for precipitation than the normal overflow from the two primary thickeners.

The underflow of pulp from the 25-ft. thickener is lifted by a diaphragm-pump, diluted with low-grade solution to a 3 : 1 ratio and run to the first of the Trent replacers, which it enters over an umbrella-shaped device for preventing undue disturbance of the surface of the charge. This distributor is set in the centre of the vat, with its edge flush with the surface, so that the pulp particles begin settling at once, while the incoming solution, mingling with the clear solution on top of the charge, overflows into an annular launder. The pulp thickens in the bottom of the vat, where it is kept in circulation by the centrifugal pump, connected like the one serving the agitator, except that the return connection from the vat to the pump-suction is situated about two feet above the bottom of the vat. Fresh solution is introduced into the pump-suction and intimately mixed by the pump without disturbing the upper or settling-zone, and a steady withdrawal of pulp from the pump-discharge, at a ratio of 2 : 1, is made to the first of the Dorr agitators, the volume being regulated by a valve in the 2-in. line. The passage of the pulp through the Dorr agitators, with a thickening before the final agitation, has already been described. The progress through the thickeners is as herein indicated, but it has been found advantageous to vary the flow of solution therein as shown on the flow-sheet, thereby getting better washing and quicker settling.

From the last of the secondary thickeners, the pulp is discharged by static pressure to either one or both of two Trent replacers. These usually are operated in series, but they can be operated separately or in parallel. In them the pulp is further washed by replacement with fresh barren solution, and finally discharged at a ratio of 2 : 1 to the thickener preceding the filter. No further dilution is made to the pulp entering this thickener, as its principal function is to furnish a supply of properly thickened pulp to the filter. The solution overflowing from this thickener joins the combined overflow from the last two replacers. A portion of this mixture of low-grade solution is used on the first replacer, while the remainder goes to storage.

On the filter, a barren solution is used on the upcoming side, and a water-wash on the downgoing side, the cake discharged containing about 25% moisture. It has not been in steady operation long enough to enable exact figures to be quoted in this article, but those available indicate a capacity of about 140 tons of dry pulp per day, with low losses in cyanide and dissolved precious metals.

The plant now handles from 110 to 120 tons of ore per day, assaying $20 per ton. The total recovery is about 90%, the percentage increasing with an increase in the value of the ore, as a rule, and within certain limits, dependent on the character of the ore. If this contains most of the uncombined metal, a very slight rise in the residue of undissolved metal follows a rise in the value of the heads, but if there is much telluride present, the rise

is very marked. It is apparent from the foregoing description of the treatment that an unusually long contact with cyanide is secured and many additions of fresh solution made during its course, with the result that there is very little loss in dissolved gold or silver, but the loss in undissolved metal has always been and is still rather high. The justification for such long-continued treatment lies in the fact that whereas about 80% of the assay-value is dissolved readily in the first stages of treatment, there is a residue that resists stubbornly the action of cyanide, the result being a slow but continued dissolving that lasts throughout the treatment. From the time the ore enters the mill until it is discharged is about seven days, which should be ample for almost complete dissolution of the precious metals were it not for the fact, well-established by experimentation, that there is a definite amount of gold and silver in combination with tellurium. Repeated experiments on the tailing disclose the facts that the slime portion (finer than 200 mesh) contains the major part of the undissolved metals, and that, whereas the concentrate from the tailing stream has a value of about $30 per ton, the percentage represented by this is so small as to account for considerably less than half the loss. It is evident, therefore, that it is mainly due to the presence of very finely disseminated high-grade mineral, with the gold and silver in combination; so that concentration offers no remedy. Experiments have been made on the tailing by flotation with indifferent results (the pneumatic method being used), and laboratory experiments on the concentrate recovered from the tailing by panning or table-work, including re-grinding and re-treatment with stronger solution, have invariably shown poor dissolving action with heavy loss of cyanide. A recent series of experiments conducted in the United States on a lot of concentrate recovered from the tailing upon a small Wilfley table gave no better results, but a re-concentration of the concentrate yielded a product, cut from the extreme upper edge of the table-flow, that represented 0.638% of the total; this assayed 41 times as high in gold, and analyzed 0.5% in tellurium. It represented but a very small fraction of the loss in the tailing, but its segregation is of great interest as showing in a magnified way the undoubted presence of tellurium, which, by the way, was present in this product in a much greater proportion to the gold than called for in any mineral combination of the two. This is explained on the assumption that a considerable proportion of the gold originally combined with this tellurium had been dissolved during the course of treatment.

It is apparent, therefore, that the treatment of this ore presents difficulties that are hard to overcome, and that while they have received careful consideration from those in charge, with improved results, there yet remains the problem of increasing the dissolving action without too greatly increasing the cost or prolonging the treatment beyond the point of economy. No re-treatment scheme suggested so far appears to be practicable or profitable. No doubt, if the topography and climatic conditions permitted the impounding of the tailing, nature would soon break up whatever combinations may exist, but it would result in so many oxidation products harmful to cyanide that it is doubtful if re-treatment would be profitable. It is likely that if a method of increasing the recovery be found, it will be within the limits of the present treatment, rather than in the addition of other methods preceding or following.

Vanadium Corporation

The Vanadium Corporation of America announces that its total income after all charges, taxes, etc., amounted to $1,319,513 for the six months ended June 30, 1920. The gross sales during this period amounted to $5,966,-046. The first of the year it took over the Primos Chemical Co., a producer of tungsten, molybdenum, and vanadium with mines in Colorado and a treatment plant at Primos, Pennsylvania.

The vanadium properties are situated at Minasragra, Peru, in the Andes mountains at an altitude of 15,800 ft. They are reputed to be the richest and most productive deposits in the world and produce 80% of the world's supply. The roasted ore was formerly carried on the backs of llamas to the railway, but at the present time the Foundation Co. is constructing a 6-mile 30-in. gauge railway from the mines at Minasragra to Lake Pun Run. From this point the ore will be ferried 9 miles across the lake on 25-ton barges and loaded on motor-trucks for transportation to the railway at Rincran, a distance of 15 miles. The present production will be greatly increased when this railway is completed. The vanadium occurs in the form of patronite and is mined by open-cut workings. This ore is roasted and packed in 125-lb. sacks and shipped to America. The ore-reserves are estimated to amount to about 38,000,000 lb. of vanadium or a 20 years supply, the amount being approximately 100,000 tons and the grade 19% vanadium.

It is proposed to erect a treatment plant at Jumasha on the shore of Lake Pun Run to concentrate the ore and ship a product running 80% vanadium oxide.

The smelter at Bridgeville, Pennsylvania, is equipped with two electric furnaces capable of producing 75,000 lb. of vanadium from the re-treatment of the slag accumulation of many years, besides an aluminum reduction process for the roasted ore. At Vanadium, Colorado, the Primos company operates a vanadium mine and reduction plant, another vanadium mine at Placerville and a third mine at San Pete. A molybdenum mine and mill are situated near Empire, Colorado, and in Boulder county, Colorado, it operates a number of tungsten mines and a large concentrator. The concentrates from all these properties are shipped to the treatment plant at Primos near Philadelphia, Pennsylvania.

Vanadium finds its chief use in the manufacture of alloy steels, where it has met with great success ever since its introduction in 1905. Molybdenum is also used for alloying with steel. Tungsten is used for steel-making, in the manufacture of lamps, and other industries.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

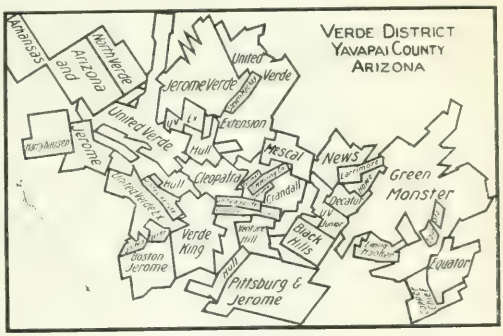
ARIZONA

SHATTUCK ARIZONA COPPER REPORT.—UNITED VERDE WILL NOT CURTAIL FURTHER.

BISBEE-WARREN.—The report of the Shattuck Arizona Copper Co. for the quarter ending September 30, 1920, shows a loss for the quarter, exclusive of depletion, of $19,109. The report says in part: "Lead mining and milling operations have been conducted at nearly full capacity of the concentration plant. The production of copper, and of gold and silver from copper ores for the quarter, was less than previous quarters due to less copper ore mined. The production of lead, and of gold and silver from lead ores, was considerably more than in the previous three months due to more tons milled and to better grade." During the quarter the company produced a total of 2,405,250 lb. of lead, 527,454 lb. of copper, 137,164 oz. silver, and 1436 oz. gold. A total of 2150 ft. of new development work was done during the quarter. The company laid off about 100 men on November 24, and will shut-down completely as far as mining operations are concerned, on January 1. At that time the entire force, with the exception of about 40 men who will be retained to carry on development work, will be laid-off. The Denn Arizona Copper Co., which is under the same management, has been shut-down since November 1.

The Calumet & Arizona Mining Co. is maintaining its force and contemplates no reduction that will effect underground operations. The company is employing a few men but is making no effort to increase its present working force. The Copper Queen branch of the Phelps Dodge Corporation will continue operations on the present basis, and does not at present contemplate making any reduction in its working force.

JEROME.—The recent visit of Charles W. Clark, general manager for the United Verde, to the company's mines in Jerome, has set at ease the minds of those who were apprehensive of a complete shut-down of the mines and smelter. Mr. Clark is reported as being decidedly optimistic as to the future and as expressing the opinion that a general improvement in conditions will probably take place early next year. In the course of an interview, Mr. Clark is quoted as having said: "The United Verde company has a splendid organization and we would break it up only with the greatest reluctance. We would much prefer to run along as at present for several months, even at a loss. Today we are employing approximately 60% as many men as we did at the peak of war production, and are turning out about 40% as much copper. We will cut down the force only a very little bit more here at Jerome. It is possible that we will suspend steam-shovel operations entirely for a short time. At Clarkdale there will be no further curtailment; two furnaces will be kept going. Positively there will be no shut-down. We have no intention whatever of closing our mine and smelter. On the contrary we have high hopes that in a month or so we can begin gradually to put on men." Mr. Clark



also expressed optimistic views anent the labor situation, and in regard to the likelihood of an early wage-cut in the copper industry is reported to have said: "Such a thing has never been discussed by Arizona copper producers. I read that Michigan companies have reduced wages 15% but no such step is contemplated here. Of course, in the general readjustment wages will probably have to come down along with the products of the country."

Some speculation as to whether the Jerome-Verde was considering the resumption of active operations was created by the presence in Jerome of I. Mabbett Sutton, secretary of the company. Mr. Sutton, however, gave it as his impression that development work would not be resumed for at least a year, adding by way of explanation that "wages and materials are so high that we cannot consider resuming development at this time, though we would like to do so in preparation for the time when copper will be back to normal prices".

Steam-shovel operations at the United Verde Copper Co. are reported to have uncovered an orebody approximately 75 to 100 ft. wide, lying west of the former office building. The size of the orebody has not yet been ascertained, but the contents are said to assay over 4% copper. Important changes are said to be contemplated by the

Western Chemical Co. in regard to the development and operation of its sodium-sulphate deposit south-west of Camp Verde. It is probable that, instead of shipping the sulphate as extracted, the company will set up a washing-plant on the ground. This equipment is expected to arrive shortly after the first of the year. The necessary water will be piped from Copper canyon or pumped from the Verde river. The process in general will consist of grinding the sulphate to powder, washing out the dirt, allowing the remaining sulphate to crystallize and then sawing it into blocks for shipping. Considerable development work has been done, and the results indicate a large reserve of sulphate.

COLORADO

VANADIUM ORE DISCOVERED NEAR TELLURIDE.—STEEL FOR SMUGGLER UNION MILL ARRIVES.

CENTRAL CITY.—The Coeur d'Alene property was recently visited by T. H. Jenks, consulting engineer for the National Finance & Holding Co., of Toledo, Ohio, who completed arrangements for resumption of work. This property is an early-day producer with a record of better than $155,000 mined from shallow workings. The deepest shaft is but 400 ft. deep. G. E. Bolander, of Black Hawk, has been engaged as superintendent and a force has been put to work re-timbering the shaft, repairing mine buildings, and overhauling machinery.

J. Larsen, of Denver, and associates are unwatering the Ridgewood mine. The property has been long idle, but the shaft-timbers to the water-level were found in good condition.

CRIPPLE CREEK.—The new station at the 2450-ft. level of the No. 2 shaft of the Portland Gold Mining Co., on Battle mountain, is nearing completion, and cross-cutting will shortly commence, to prove the continuation of the rich ore now under development on the two levels above the 21st, corresponding with the Roosevelt tunnel-level. Foundation for the hoist, formerly in operation at the Gold Coin shaft of the Granite company at Victor, has been completed. A new screening plant is also being installed. The Independence mill continues operating on low-grade ores, the higher grades being shipped to the Golden Cycle mill at Colorado Springs.

IDAHO SPRINGS.—The Denver tunnel at Empire is being re-timbered preparatory to the resumption of work. The bore has been driven 1800 ft. and ore of a milling grade is reported in the breast. The vein will be opened by drift and shipments will commence the first of the next year. The Gem mine is producing mill-ore in tonnage sufficient to keep the Newton mill operating on two shifts.

The Elliott-Robinson company has a force of miners employed cleaning out and re-timbering the Silver Age tunnel. The tunnel, a former producer of high-grade ore, but long idle, was found badly caved; it will be made safe before operations are resumed. The shaft at the French Flag mine is being unwatered preparatory to resumption. The Columbia mine at Empire is again active and a promising ore-shoot is reported by F. E. Birdsall, operating the property, as having recently been opened by a drift. Ore is now being saved for shipment.

LAKE CITY.—The Standard Mines Development Co. reports a rich discovery of gold-silver ore in one of the old tunnels on the Little Chief; samples assay as high as 22 oz. gold and 1200 oz. silver per ton. A camp has been established at the mouth of this tunnel, two miles from Lake City, and ore is being saved for shipments to start December 1. The Little Chief is owned by the Thatcher estate and is operated under lease and bond. Christie and Atkins, of Lake City, operating the Ute mine under lease from Samuel D. Nicholson, of Leadville, have opened up high-grade ore and have made two shipments. The ore now being mined is reported the richest mined in the San Juan for the past 20 years. No figures, however, are available.

The Goldona Mines Co. has acquired the Dewey No. 2 lode, the Bob Ingersoll, and other claims adjacent to the Goleonda group, and will continue operating this winter through the Dewey No. 2, situated on the Hurricane basin side, which is more accessible. Rich ore has recently been found. Plans for development by a long cross-cut tunnel have been perfected and will be started while blocking out of ore-reserves for spring shipment is continued.

LEADVILLE.—A 'grass-root' discovery is reported from the Sugar Loaf district on the Fanchon placer. Ore assaying as high as $200 per ton in gold has been opened by lessees on the Fugan section of the placer. The extent of the orebody has not yet been determined.

SILVERTON.—The rich ore recently opened on the Ariadne persists with additional drifting; the force of miners will be increased when stoping ground is opened. The Iowa Tiger continues steady production for its mill and a good grade of concentrate is made. Operations will be resumed by December 1 by the Gold King Extension Mines Co. with a larger force than when the property closed temporarily last month. Good orebodies have been opened on the Gold King and other properties and reserves available will keep the Gold King mill in continuous operation for a long time ahead. Rich ore is reported exposed in the tunnel on the Eastern Star mine, although details of the discovery are not yet obtainable.

TELLURIDE.—The Colorado Vanadium Co., following discovery of vanadium-bearing ore in the White Cliffs near this city, has had its geologist and surveyor in the field and has made several locations. Henry Williams, who made the original discovery, appears to have located the ground carrying the strongest visible vein and may realize ample funds to keep him in comfort the remainder of his life. He is 70 years old and has for many years searched for a phantom 'lost lode' of gold ore. Scores of locations have also been made by citizens, business men, and miners in Telluride. Structural steel for the new flotation plant of the Smuggler Union company, contained in nine railroad cars, has been unloaded here and hauled to the mill-site. Other material and machinery has been sent forward and the contractors expect to have the building completed and machinery installed early in the spring.

MICHIGAN

COPPER RANGE MINES WILL NOT CURTAIL.—PRODUCTION AT MOHAWK AND WOLVERINE PLANTS IS BEING INCREASED.

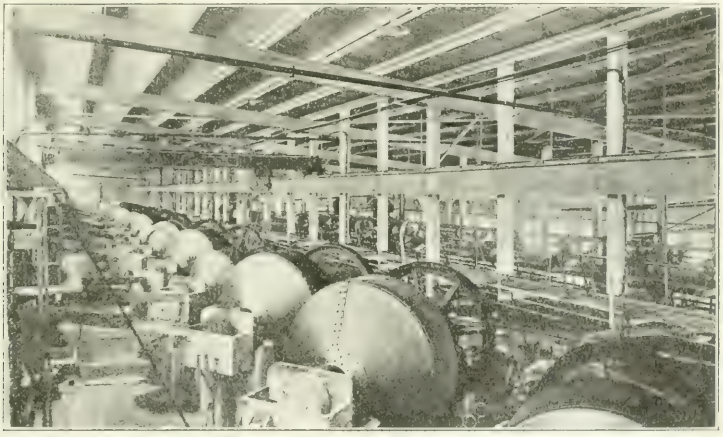
CALUMET.—The extent of the curtailment at the Calumet & Hecla mines and the readjustment in all surface departments, including mills and smelters, indicate that production of these properties will continue at an unusually low figure for the next six months. The Hecla mill has been closed and all 'rock' will be stamped in the Calumet mill. That plant will operate at capacity on conglomerate 'rock'. The reclamation plant has not curtailed and the output from this department will continue around 1,000,000 lb. of copper per month. The reduction by the parent mine will be about 600,000 lb. per month, representing the output from the Osceola lode branches. Surface forces are being reduced about 50%. In some of the shops, at the employees' initiative, a half-time schedule is to be put into effect rather than curtail to a great extent in forces, with the men working three instead of six days per week.

The drastic curtailment by Calumet & Hecla reflects the demoralized condition of the metal market and the only hope for the restoration of normal conditions appears to depend on the absorption of the existing surplus. It is estimated that Calumet & Hecla has $12,000,000 tied up in unsold metal. With the navigation season practically at an end there does not appear to be any likelihood that rail shipments in large volume will go forward inasmuch as high freight-rates add so much more to the cost of production.

The extent of the curtailment at Ahmeek and Isle Royale, the only other two mines of the Calumet & Hecla group now operating, has not been announced, but it is understood that Ahmeek's output will be such as to keep all stamping units at the mill in operation.

Ahmeek's October production in refined copper, 1,759,100 lb., is an increase of approximately 150,000 lb. over September and was exceeded during the past six months only in June. The output of Calumet & Hecla's conglomerate department was 2,753,891 lb.; the reclamation plant recovery was 1,057,735 lb.; and the Osceola amygdaloid branch produced 735,333 lb. This is an improvement of 332,535 lb. for the reclamation plant over September but it is 300,000 lb. below the figures for May and June. Isle Royale's October production was 831,700 lb., compared with 727,864 for September, while LaSalle reported 14,413 lb. for October. Superior's October operations yielded 38,066 lb. and White Pine produced 76,000 lb., a decrease of about 5000 lb. from September. The total output for the Calumet & Hecla group was 7,943,502 lb., compared with 7,288,214 in September.

The Copper Range mines will not curtail forces. On the other hand a small number of men are being taken on at Champion and Trimountain. Production is now but little better than 50% of normal, but it is expected that this will be increased somewhat. Quincy also does not propose to curtail and is employing some additional underground men. Some of the Calumet & Hecla men have been taken by Mohawk, Wolverine, Quincy, and Copper Range. Seneca also has increased its force during the past ten days.



INTERIOR OF A MICHIGAN CONCENTRATOR

Wolverine has begun to return to normal production, with the pre-war peak as the basis, and within three weeks or a month, another head in the Wolverine mill likely will be started. Production of 'rock' is steadily climbing as the result of increasing the force of miners, trammers, and laborers. Wolverine has begun to take out the shaft-pillars, beginning at the 38th level, from which all bodies of profitable ore have been mined, and as other levels are completely stripped of commercial 'rock' the work will proceed upward. The removal of the pillars does not necessarily mean that the shaft will come together, yet if the explorations on other veins reveal ore it is not likely the pillars will be removed at present above the 28th level. The pillars, it is estimated, will bring

Wolverine's yield up to between 17 and 18 lb. per ton and this recovery likely will be maintained for the remainder of the mine's life, so far as the Kearsarge amygdaloid is concerned. There likely will be stretches of ground in the pillars that will be found remarkably rich and an immense amount of copper will be extracted from them, for the pillars are about 90 ft. square and extend from the surface to the bottom.

Mohawk is taking on fairly large numbers of miners, trammers, and laborers, including many former Calumet & Hecla underground men. As soon as the force is built up to completely man No. 4, 5, and 6 shafts, it is proposed to open No. 1, as well as push the development of the fissure vein between No. 4 and 5 shafts. The fissure has been opened for a distance of about 700 ft. south of No. 4 on the 22nd, 23rd, and 24th levels, and it has been found to be mineralized for a width of from two to three feet, chiefly in the hanging wall. There also is copper in the foot-wall in certain spots but the hanging-side yields the larger amount of mineral. The main walls of the fissure vary from a few inches to eight and twelve feet in thickness and in places the vein is found to be exceedingly rich. No. 1 shaft is bottomed on the 26th level but there are large tracts of ground on the upper levels that will be removed in widening out drifts and extending the stopes to the foot and hanging walls.

Instead of curtailing operations, as has been done by Calumet & Hecla, the Mohawk and Wolverine plants are to materially increase their forces in the hope of earning money by quantity production on a low market. Mohawk's output, accordingly, will be pushed to 2400 tons or more per day from Wolverine and it is proposed to maintain shipments at a rate of 1200 tons per day from Wolverine. This will necessitate the operation of practically all the stamps in the two mills, whereas, prior to two weeks ago, only the Mohawk mill was operating to crush all the 'rock' that could be mined from the two plants.

Arcadian Consolidated is still operating and the management expects to continue through the winter. The vein continues to appear in the shaft at intervals and wherever it is exposed as the shaft deepens there is a splendid showing of mineralization. The station at the 750-ft. level will be cut about the middle part of the coming week and a small drift, north and south, may be put in at that point. This level will be the only one to be put in on the sixth level to collect water that flows from the upper levels and as fast as it fills the water will be permitted to run into the bailers.

NEVADA

ORIZABA PROPERTY IS SOLD.—GOOD ORE FOUND ON THE 1100-FT. LEVEL OF THE RESCUE EULA.

Orizaba.—The property of the Orizaba Mining & Development Co., 36 miles north of Millers, the shipping point, has been sold to a syndicate of New York men headed by A. M. Page, Bartlett Smith, and George B. Hutchins. The Diamondfield Black Butte at Goldfield also was sold as part of the deal. The Orizaba consists of nine claims. The main vein is on a contact between highly metamorphosed limestone and an altered granite intrusive, according to a report made by J. K. Turner of Goldfield. A fault-fissure near the contact cuts and interrupts the ore-bearing vein, and where the drifts have followed the fault-gouge and breccia only low-grade ore has been found. The ore on the upper or 65-ft. level is stained quartz containing silver chloride and a little gold. On the lower level the ore consists of fine-grained quartz, some calcite, zinc sulphide, small quantities of galena, and silver sulphide. Two veins join with the main vein, but little work has been done in them. The development work totals 1300 ft. The main shaft, 120 ft. deep, contains water to 95 ft. from the surface. The shaft, sunk in or near the foot-wall of the vein, dips at 70°, about the same as the vein. Drifts on the 65-ft. level are 550 ft. long, 150 of which is east of the shaft and 400 west. Drifts have been driven 130 ft. east and 220 ft. west on the 85-ft. level. The west drift is caved from the 170-ft. point. An average of all samples assaying more than $9, which is estimated to be the minimum for mill-grade ore, showed an average width of 3½ ft. and a value of $19.32 in silver. The gold content is unimportant. Mr. Turner estimates that the dumps contain 300 tons of $21.30, 3000 tons of $11.80, and 300 tons of $9.80 ore, a total value of $44,730. Ore of a gross value of $22,980 and a net value of $16,155 has been shipped. The shipment contained 42.3 oz. silver per ton at 91⅞c. per oz. Mr. Turner advises that the use of steam-power be discontinued and that a new shaft be sunk in the hanging wall of the vein in order to avoid the water.

Tonopah.—Ore in a vein five to six feet wide, assaying $40 to $60 for this width, has been found at a depth of 1100 ft. in the Eula claim of the Rescue Eula. The ore was found in a drift driven east on the foot-wall side of a flat-dipping vein 20 ft. wide. The vein is broken west of where ore was found, but the condition in the ore-shoot is good.

Virginia City.—The tunnel of the United Comstock has been driven 100 ft. from the portal and three shifts of miners are continuing it at a rate of 15 ft. daily. The tunnel will be double-tracked and two 6-ton electric locomotives using storage batteries will be used for hauling. It is also planned to use a shoveling machine. The company is preparing to drive the tunnel from the Imperial, Belcher, Knickerbocker, and Jacket shafts. The surface plant at the Knickerbocker is practically complete, crosscuts from the Belcher and Jacket are nearing points from which the tunnel will be started, and sinking of the Imperial shaft will be resumed in a few days. Zeb Kendall has been elected president of the Consolidated Virginia, Mexican, Ophir, and Union companies in place of Alex Wise, who hereafter will devote his entire attention to his position as superintendent for these companies.

Pioche.—The Salt Lake Route has announced a proposed reduction in rates as follows: $6.50 ore, from $2.75 to $2.20; $8.50 ore, from $3.50 to $2.80. Lower rates on this grade of ore are of great importance to the Pioche

companies, as they will permit shipment to Salt Lake smelters of much ore that otherwise could not be profitably mined.

COALDALE.—The Darms Coal Mining Co. will unwater the 600-ft. shaft and will use a diamond-drill at the bottom to prospect two veins that should be cut 50 and 150 ft. below the shaft. H. A. Darms has the largest interest in the company and Tonopah people are reported to have invested heavily to furnish funds for resuming work.

DIVIDE.—Drifts are being driven south-east on the 800 and 1000-ft. levels of the Tonopah Divide and the crosscut on the latter is being continued through the vein. Important work also is being done on and above the 1000-ft. level.

GOODSPRINGS.—The employees of the Yellow Pine mine and mill have accepted unanimously a 50c. reduction in wages. Board was reduced 10c. when the wages were cut and prices will be reduced in a store operated by the company. The cause of the cut in wages is the low price of zinc ore.

LAS VEGAS.—The Tiffany mine near Crescent, a producer of turquoise, is being worked by the owners, J. B. Horne and Mrs. G. Jordan, who plan to eliminate the middleman in marketing the stones by employing a cutter. Crescent is on the Nevada-California line 15 miles west of Searchlight. Some of the stones when cut are said to be worth $15 to $35.

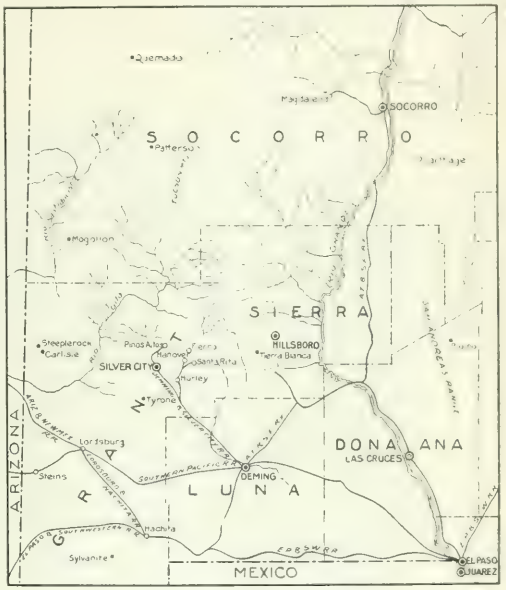
TYBO.—The smelter and mill of the Louisiana Consolidated have been closed because of a shortage of ore, according to reports, but development work in the mines is being continued.

EUREKA.—The following shipments over the local railway during the past week were consigned to the Utah smelters: by the Richmond-Eureka Mining Co., 21 cars of speiss; by the Eureka-Croesus Mining Co., 3 cars of ore, and the Eureka-Holly Mining Co., 8 cars of ore. The Eureka-Holly Mining Co. is timbering its shaft down to the 500-ft. level and is cutting out a station on that level and sinking its shaft deeper. Carpenters are progressing with the construction of the company's mill building. A new pump has been ordered by the Eureka-Croesus Mining Co., to be substituted for one hitherto used for pumping water from the bed of New York canyon. Ore is being extracted from four different places. Sinking continues in No. 8 winze, and a drift has been started on the ore-shoot. The management reports that these workings have furnished most of the 100 tons of ore that was shipped during the past week, and good ore is still showing at the bottom of the winze. Of the 100 tons, 50 tons was shipped last week and 50 tons this week. Ore continues in the 'shale' raise which is adding its quota to the shipments. The ore in No. 7 winze is reported to be holding out well, and five mine-cars are the average of the daily production. A raise has been started in the foot-wall of the old Dunderberg workings and is said to be in good ore. It is expected to ship 50 tons of ore from the mine next week and make a start for still another shipment. The winter's supply of powder and distillate for the mine has been received.

NEW MEXICO

NEW MILL AT RED ROCK.

SILVER CITY.—The Silver Spot Mines Co., organized in 1919 by Silver City capitalists, started operations in January 1920 on Boston Hill in search of the extension of the silver-bearing orebodies of Chloride Flat which made Silver City famous as an early producer of silver ores. Work has been discontinued owing to large quantities of water developed at about 150 ft. This made difficult the original intention of the company to sink to 300 ft. Development succeeded in disclosing the presence of silver-bearing ores, associated with manganese ores. Several carloads of the latter were shipped. The



SOUTH-WESTERN NEW MEXICO

company plans early resumption of work when arrangements are completed for handling the water.

WHITE SIGNAL.—Operations have been suspended on the radium-bearing ground at White Signal, where for several months the Radium Company of Colorado has been actively engaged in determining the extent and content of the torbernite ores. Development operations are understood to have been unsuccessful, owing to the fact that the torbernite ores were of low grade and presented difficulties in extraction which could not be successfully met by present metallurgical practice. The Co-Operative Mining Co. of Lordsburg has purchased all of the equipment used by the Radium Company of Colorado.

LORDSBURG.—A 200-ton mill is to be erected at the Great Eagle mine at Red Rock, which was recently acquired by Eastern capital. Frank Groh is in charge of construction.

STEEPLEROCK.—The Duncan Mining & Milling Co., which completed its new cyanide mill in July of this year and ran for some time on the ores of the district, has gone into the hands of a receiver.

COLUMBUS.—The Metals Exploration Co., of which O. Wiser is president, has purchased the Manning group of claims in the Tres Hermanas mountains, as well as adjoining claims owned by T. G. Lockland and others. Houses have been erected, an engine, hoist, and compressor are on the ground, and development has been started.

PINOS ALTOS.—The Calumet-New Mexico concentrator south of Pinos Altos is again operating on ores from the Manhattan mine. Ore shipments from Lordsburg for October were 80 cars of an approximate gross value of $70,000.

UTAH

FREIGHT RATES REDUCED.—NEW WORK PLANNED AT SILVER KING CONSOLIDATED.

SALT LAKE CITY.—Freight-tariffs will be published during December by the Salt Lake Route and Western Pacific railroads announcing reductions in rates on certain classes of ores. The Salt Lake Route will reduce the rate on ores up to $15 per ton and the Western Pacific will reduce rates on ore valued at more than $60 per ton. The reduction announced by the Salt Lake Route will benefit sundry shippers in Nevada who produce low-grade ore. The Western Pacific Railroad reductions will benefit Nevadan and Californian mines, served by its lines. Application has been filed with the State Land Board for the lease of 640 acres of land for the development of potash, alunite, and associate minerals. The section involved is in the mineral district just east of Marysvale, in Piute county. The application was filed by Chicago and Indiana capitalists. The directors of the Cardiff Mining Co. have declared a dividend of 15c. per share, payable November 29. This is the only dividend declared this year and totals $75,000. The grand total to date is $875,000.

PARK CITY.—During the week ending November 20, the Judge properties shipped 590 tons of ore; Ontario, 511; Silver King Coalition, 394; and the Keystone, 110. The milling plant of the Glenallen Mining Co. is nearing completion and it is expected to be in operation by December 15. At the present time only development is going on in the mine, but as soon as the mill is finished a full force will be put on to supply the required tonnage of low-grade ore. At the Park-Utah property, the '15-4' fissure, which has been followed for more than 1000 ft., producing considerable second-grade ore, with occasional pockets of high-grade material, has recently opened a body [illegible] of first-class ore which has indications of developing into a large body.

Solon Spiro, president of the Silver King Consolidated Mining Co., recently returned from New York. When asked regarding conditions at the property, he stated that arrangements are being perfected to start two raises. A three-compartment raise will be put up on a series of fissures just north of the large dike recently cut by Spiro tunnel, to the overlying limestone. Another raise will be put up on the body of iron ore, containing some gray copper, silver, and gold, opened up last month for a distance of 40 ft. at the side of the tunnel. Operations were suspended for a week at the Naildriver property, owing to trouble with the boiler-plant. Work in the mine is being done on the 500, 600, 700, and 900-ft. levels, according to J. D. Fisher, superintendent.

EUREKA.—T. H. Heal, president of the Greeley Mining Co., in the northern part of the district, visited the property recently with Charles Zabriskie, mining engineer of Salt Lake City. Mr. Heal states that the visit was for the purpose of selecting a shaft-site and that it is the intention of the company to commence sinking at once. There has been little activity in the northern part of this district for some time, and mining men familiar with the ground believe the Greeley to be a property of exceptional promise. Shipments from this district for the week ending November 19 totaled 153 cars, of which the Tintic Standard shipped 38; Chief Consolidated, 37; Dragon, 17; Eagle & Blue Bell, 13; Grand Central, 8; Mammoth, 7; Iron Blossom, 6; Victoria, 5; Iron King, 5; Gemini, 4; Swansea, 4; Centennial Eureka, 2; Bullion Beck, 2; Eureka Hill, 1; Gold Chain, 1; Sunbeam, 1; and Colorado, 1.

At the Zuma property, work is being carried on in two places. A drift to the south-east from the bottom of a 75-ft. winze was started recently, and a streak of high-grade ore has been cut. On the 800-ft. level, a drift is being sent to the south. Recently the main shaft has been re-timbered. An assessment of one cent per share, for the purpose of carrying on development, has been levied, delinquent December 20, with sales-date January 11. At the Little May property, adjoining the South Standard, a 4-in. streak of gray copper has been opened on the 190-ft. level. Within five feet it has widened to 14 in. An average sample gave returns of 13% copper and 4 oz. silver per ton, according to John Matson, the president of the company.

The Tintic Standard Mining Co. has awarded a contract for the erection of additional dwellings and lodging-houses at its mine in the eastern part of the district. Excellent progress is being made on the concentrating plant being erected on Warm creek; it will be ready for operation soon after the first of the year. The Mammoth Mining Co. has entered into a temporary arrangement with the A. S. & R. Co., which will permit the resumption of mining copper ores. It is expected that a similar arrangement will be made that will enable the company to resume shipping from its mill-dump.

[illegible] Encouraging developments are reported from the property of the Southern Pacific Gold & Copper Mining Co., in the Sierra Madre district, 10 miles north of here, according to H. A. Strauss, manager. The floor of the shaft now shows about six feet of excellent mineralization, averaging $3 in gold, 1.2 oz. in silver, and 17.58% copper. Within another 20 ft. of drifting, it is [illegible] will be reached.

BRITISH COLUMBIA

SILVER STANDARD MINE IS SHUT-DOWN. BRITANNIA TEMPORARILY SUSPENDS PRODUCTION.

VANCOUVER.—The Coast Range Steel, Ltd., has been incorporated with a capital of $15,000,000 for the purpose of erecting an iron and steel plant in British Columbia. Arrangement has been made with the government of British Columbia for a bounty of $3 per ton of iron produced from British Columbia ore during the first three years of the plant's operation. An effort is being made to induce the Federal government to permit machinery for the plant to be imported duty-free. The provisional directors are: H. J. Landahl, F. T. Congdon, J. D. Kearns, and Montague Moore, of Vancouver, and John Steta, of New York. Other mining companies that have been incorporated recently are: The Soda Mining & Products, Ltd., $75,000; Alice Arm Holdings, Ltd., $1,000,000; Crescent Oil Holding Co., Ltd., $175,000.

The Britannia Mining & Smelting Co. has discontinued production and will not ship any concentrate to the Tacoma smelter until either the price of copper advances or working conditions allow of the production of copper at a reasonable profit at present prices. Under ordinary conditions the Britannia employs between 600 and 700 men. About 250 men have been discharged, and these have come into the city, where already there are many unemployed men, notwithstanding approaching election time, when it is the custom for the party in power to 'make' temporary jobs with the view to gaining votes. Last year, the Britannia was the only copper mine in the Province to show an increased production, the output for the year being greater than in any previous year. During the year 640,000 tons of ore was mined, 615,000 tons milled, 17,250,000 lb. of copper, 98,600 oz. of silver, and 4200 oz. of gold were produced. Development work will be continued, but unless production is re-started by the beginning of the year it is probable that more men will have to be removed from the payroll.

PRINCE RUPERT.—Owing to the marked decline in prices of lead and zinc, the Silver Standard mine, at New Hazelton, is to be closed entirely. It had been intended to continue the development of the mine and shut-down only the mill. Recent discoveries of gold-silver-copper ore, with gold predominating, on Princess Royal island, have caused considerable local excitement, and it is likely that much development work will be done on the island next year. The formation is said to resemble that found at the Surf Inlet mine.

TRAIL.—F. H. Jackson, of Rossland, and Denver associates have purchased the White Swan group, at Burnt Basin. Development of the property will be started next spring. The ore received during the second week in November at the smelter totaled 8187 tons, of which the Consolidated M. & S. Co. mines were responsible for 7527 tons. The United mine, at Ainsworth, appeared on the list for the first time this season. The Associated Eastern B. C. Boards of Trade have petitioned the Federal government for an investigation into the prices of

SOUTH HECLA MINE AT ALTA, UTAH

coal and coke and have asked for a revision in the freight-rate for coke. It was decided, too, to hold the next annual mining convention at Grand Forks.

AINSWORTH.—Thomas and Joseph Haws, George McPherson, Glen McLeod, and E. and D. McLennan have taken a lease of the No. 1 mine from the Consolidated M. & S. Co. The mine has been a good producer and is well equipped. Last year it produced 235 tons and this year, to date, it has produced 336 tons of high-grade ore. There is a tramway from the mine to the landing at Cedar Creek and a wagon-road to Ainsworth, eight miles away.

ONTARIO

CHAMBERS-FERLAND FINDS HIGH-GRADE ORE.—HOLLINGER HAS INCREASED WORKING FORCE.

COBALT.—The Mining Corporation, which is the largest individual power consumer in the Cobalt field, has reduced its consumption to the extent of about 700 hp. This step, together with somewhat similar action as some of the other mines, including complete curtailment at the Beaver Consolidated, has relieved the power shortage.

Working under a leasing arrangement through a shaft on the Right of Way Mines, the Chambers-Ferland has extended a cross-cut 150 ft. into its own property and has made an important discovery of silver ore. At the point where the find has been made, the cross-cut lies in a layer of slate. Over a width of 4½ ft. the average silver content is 28½ oz. per ton, while the lowest assay across 22 ft. is 5½ oz. The conglomerate formation is estimated to lie about ten feet below the cross-cut, and with such silver minerals shot up into the usually unproductive slate, the conglomerate is likely to contain a high-grade deposit. This is the official declaration based upon former results in the Chambers-Ferland.

Press dispatches convey the intimation that the Ontario government is considering a plan to relieve any hardship which may have been caused by the application of an Order-in-Council of October 13 which declared all patented mining claims in Ontario forfeited to the Crown, on which a certain Provincial tax of $2 per claim had not been paid. Various holders declare they received no notice, and knew nothing concerning the tax until informed that their ground had been re-located.

Dividends paid during the current year by silver and gold mining companies in the district of Temiskaming exceed $7,000,000. This represents an increase of over $600,000 over the 1919 record. The increase was due to the Dome Mines at Porcupine having resumed interim disbursements at the rate of 2% at intervals of every three months, as well as to the Hollinger having paid two extra dividends of 1% each.

T. E. Godson, mining commissioner, heard the case this week in which prospectors who re-staked the Kirkland-Hudson mine entered claim for $20,000. The defence was based upon the special Order-in-Council passed by the Ontario government which relieved the property from forfeiture prior to the hour set for such a penalty. It was considered this Order precluded any right the prospector might have had to re-stake the mine. Decision has been reserved.

PORCUPINE.—Labor conditions having considerably improved, the Hollinger Consolidated has latterly been able to increase the scope of its operations. The company has declared another dividend of 1% payable December 1 bringing its total disbursements for the year up to $1,968,000, as compared with $1,722,000 in 1919. The favorable outlook indicated has resulted in an upward movement on the stock exchange. Development work at the Dome Mines has also been greatly stimulated by the recent addition to its working forces, but the break-down of a large underground crusher, which it will take some time to repair, is causing serious inconvenience. J. P. Bickell, president of the McIntyre-Porcupine, which, in conjunction with the Temiskaming, of Cobalt, recently purchased the Blue Diamond and Canadian Coalfields coal mines of Alberta, has returned from a visit to these properties and states that excellent progress is being made with their development. New machinery is being installed as rapidly as possible and the output has already been increased 50% now amounting to 700 tons daily. Operations have been put upon a profitable basis much earlier than was expected.

MEXICO

DENOUNCEMENT OF MINERAL LANDS IN CHIHUAHUA AND DURANGO IS ACTIVE.

TORREON.—Something like the pre-revolution activity in filing upon mining claims in the States of Chihuahua and Durango is being resumed. Many of the denouncements, as these applications are called, are by Americans. Prospectors who were kept out of the mineral district of Mexico for several years on account of the revolution and bandit troubles are now returning in large numbers. Advices have reached here that a group of twenty-nine claims has been filed upon in the Velardena district during the last few days. These claims are to be developed extensively, it is stated, and if ore is discovered it will be sent to the smelter of the American Smelting & Refining Co. at Velardena. In the San Dimas district of Durango, E. H. Townsend has taken up several claims, from which he expects to produce soon. There are several rich mining districts in Durango that are remotely situated from railroad transportation, San Dimas being one of these. Another district that promises to undergo rapid mining development, now that the era of disturbances has passed, is Santiago Papasquiaro, which is rich in gold, silver, and lead ores. Joseph E. Trumbley has just filed on 22 claims in that district and will start development as soon as machinery and equipment can be installed. Ore-shipments from the various districts show a gradual increase, due to the improvement in railroad transportation. Much new machinery is now coming into the country for installation in mines. Special attention is being given to re-timbering many of the mines, and the timbers for this purpose are shipped from the United States.

ARIZONA

Globe.—It is reported that drilling to a depth of 3000 ft. on the Castle Dome property has indicated a deposit of 1.4% copper sulphide ore that is capped with 20 ft. of 2½% oxidized copper ore. Work has been suspended till spring.——Drilling of 600 acres is to be started on the Warrior Copper Co.'s property in Lost gulch with three drills. This area adjoins the Louis D'Or property. Considerable ore has already been developed by tunnels. Last year the Superior & Boston Copper Co. shipped ore to the value of $200,000 to the smelters at Miami and El Paso. Three copper-silver veins are being developed. T. R. Drummond is in charge of the work.

Grand Canyon.—The Northern Arizona Lead & Zinc Co. is working a small force of men at its mine near Catarack canyon. A considerable amount of vanadium ore, as descliozite and vanadinite, was developed in the mine a few years ago.

Kingman.—The shaft of the I.X.L. mine at Stockton hill is nearing the 350-ft. level at which point a station is to be cut and drifting on the vein commenced. The orebody at the 250-ft. level has proved to be high-grade shipping ore. The shaft will be sunk to the 500-ft. level. Complete plant for carrying on this work was recently installed and at present a large camp is under construction. G. D. Atlee is in charge of operations.——Regular shipments are now being made from the Golden Star property at Mineral Park. It is announced that a car of ore will be shipped every week or 10 days, the first car recently shipped having proved so satisfactory. The ore is high-grade silver-gold ore. Development work is being pushed and a large tonnage of milling ore is being opened apart from that which is being shipped. The drift on the 185-ft. level of the new shaft has proved the vein to be large. George Willeston is superintendent. ——The main shaft of the C. O. D. mine is nearing the 500-ft. level. Recent reports state that both drifts on the 400-ft. level are in high-grade shipping ore. Construction of the mill is progressing rapidly. The new road to the top of the hill has been completed and is stated to be an excellent road.

Miami.—It is reported that the American Asbestos Association, whose property is situated at Chrysotile, 40 miles north of Globe on Ash creek, is producing 1½ to 2 tons of sorted crude asbestos daily which is transported to Rice on motor-trucks and shipped to the mills in the East.

CALIFORNIA

Nevada County.—Announcement of the discovery of a rich vein in the South Star mine, in the Deadman's Flat district, is made by A. W. Johnson, manager for the company. A lode from three to four feet wide and running high in gold has been uncovered at a depth of 105 ft. and the prospects of developing a large ore-shoot are good.

Shasta County.—The Mammoth Copper Co., a subsidiary of the United States Smelting, Refining & Mining Co., has increased its holdings on the Shasta copper-belt by acquisition of the Crystal group of 24 claims under a two-year option. The Crystal property lies north of the Balaklala mines and west of the Vulcan property, and has been undergoing development for several years. The transaction is in line with the policy of the Mammoth company to gather in copper properties adjacent to its holdings in the Kennett district to ensue a steady supply of ore for its smelter.

Stanislaus County.—The big dredge which was launched a few weeks ago by the Yankee Hill Gold Mining Co. has commenced operations in the Stanislaus river between Oakdale and Knight's Ferry. The Pacific Gas & Electric Co. has connected the 200-hp. motor which will drive the machinery, and within a few weeks it will be known whether or not the investment of nearly $200,000 will be repaid from the gold in the channel of the Stanislaus river. The company has under lease about ten miles of the river-channel.

Tuolumne.—The Harvard mine, together with a large number of outlying claims, has been sold to John Ferguson and associates of Berkeley. The transaction includes the ten-stamp mill on the Capp-Mussel group and equipment owned by the Harvard company. While no formal announcement has been made, it is understood the new owners plan to develop the property in 1921. The Harvard long ranked among the premier producers of the Mother Lode, but has been idle several years.

IDAHO

Coeur d'Alene.—Ivan de Laschmutt, manager of the Standard Silver-Lead company's mine at Silverton, B. C., was elected chairman of the Columbia Section of the A. I. M. & M. E. at the session held at Kellogg on November 19 and 20. The following papers were presented at the meeting attended by 147 members: 'The Federal Income Tax and Mine Valuation', by W. Earl Greenough; 'Precipitation of Smelter-Fumes in Series-Treatment at the Bunker Hill Smelter', by J. P. Schuttenhelm; 'Hydraulic Classification and Table-Riffling at the Bunker Hill Concentrator', by C. Y. Garber; 'Considerations in Relation to Flotation', by Thomas M. Owens; 'Mechanical Shoveling in the Bunker Hill Mine', by William McDougall; 'Electrical Drying of Flotation Concentrates', by W. C. Clark; 'Treatment of Complex Zinc-Lead-Silver Ores of the Coeur d'Alene District', by W. G. Woolf. The papers by Mr. Schuttenhelm, Mr. Garber, Mr. McDougall, and Mr. Clark were amplified by slide views which added much to their value. Following the formal papers J. B. Parker, formerly in charge of the flotation plant at the Interstate-Callahan mill, but now at the Bunker Hill, discussed selective flotation as applied to zinc and lead, using a blackboard to illustrate the process.

The Western Union mine, situated two miles from Wallace, has 50 tons of high-grade ore ready to be sent to the Bunker Hill smelter. A new stope was opened recently which showed a foot of lead-silver ore. Ben L. Collins, of Spokane, is manager of the property.——The Hecla Mining Co. will disburse its regular quarterly dividend of $150,000 December 28. The payment will be at the rate of 15c. per share. It will increase the disbursements for the year to $650,000 and the grand total of $8,505,000. An extra dividend of $50,000 was disbursed in the second quarter. Ore has been developed to a depth of 2000 ft. in the main vein. The body is 16 ft. wide and has been followed by drift for 500 ft. or more. This body has a length of 1600 ft. on the 1600-ft. level. A streak of high-grade lead-silver ore five feet wide

is being developed at the face. The company recently acquired the Russell and Mono claims and the Tiger-Poorman group from the Federal Mining & Smelting Co. for $750,000.

Idaho County.—The Orogrande Gold Mining Co., owner of mining property near here, has completed the erection of a building and will equip a mill with a capacity of 500 tons daily, according to M. A. Sherman, vice-president. A roaster and tanks are in process of construction. The parts to be bought will be installed in time to begin operations in the spring. The plant was equipped several years ago to dress oxidized ore. The equipment being installed is designed to recover the gold in the sulphide ore. It includes leaching tanks, roaster, ball-mill, and Wilfley tables. The mine is developed and ready to yield ore.

MISSOURI

Joplin.—While the present low price for zinc ore has resulted in a curtailment of output in practically all of the mines of the district, the mines of the Eagle-Picher Lead Co. are doing all the reconstruction and repair work possible in order to give jobs to their employees oldest in point of service. Out of seven properties owned by the company, normally employing about 1500 miners, four mills are operating, namely, the Netta, Bingham, Crawfish, and Swift. The Perrin mill is being dismantled and removed to shafts No. 25 and 26 in Kansas, about 1½ miles north of the former site, where it will be known as the Bendelari mill. A drift is being made to connect shaft No. 24, near the south-west terminal station with shaft No. 20 at the Whitebird mill, where the 'dirt' will be milled. On November 20 the wages of shovelers were cut from 12½ to 11c. per can. The wages of other underground workers were unchanged.

Otis White has opened a body of zinc ore at the Buffalo mine north-west of Picher. The cave is several hundred feet long and many feet in width and is filled with the finest of 'resin jack' in chunks varying from a foot to four or five feet in diameter. The chunks will run from 45 to 50% zinc sulphide. The first day's mill-work on stuff from the cave resulted in the making of 59 cars of zinc and 4 cars of lead concentrate. The opening of the cave created something of a sensation in the neighborhood and hundreds of visitors have viewed the underground wonder, among them being many mining men of the district. The Sullivan mine at Commerce, owned by White, suffered the loss of its mill by fire one day last week. The loss was considerable, but White has not been worrying about that since he has made the big find at the Buffalo mine.

WASHINGTON

Spokane.—The American Refractories Co., operating a magnesite mine, near Valley, 50 miles north of here, has more than doubled the capacity of its truck-lines hauling the calcined product to the railroad. Eleven heavy trucks are being worked 24 hours per day. Considerable time and money has been spent in putting the roads into condition for hauling, so that trucks may run as late as possible into the season.

Obituary

Alex Shields, a prominent mining man of Hamilton mining district, White Pine county, Nevada, died on November 24 in San Francisco. He had resided at Hamilton for about 40 years. He was manager of the Ne Plus Ultra mine, which position he had held for 15 years.

Isaac E. Hadley, 69 years of age, for the past 25 years being general foreman of the American Smelting & Refining Co.'s silver-lead smelter at Murray, Utah, died on November 21. He had been a resident of Utah for 28 years, and had been connected with the smelting industry throughout that period. He is survived by his wife and four children.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers

R. C. Gemmell was in San Francisco last week.

James E. Babcock, of Los Angeles, has been at Marysville, Utah.

Ira B. Joralemon has returned from Mexico to Bisbee, Arizona.

H. R. Chartran, of Paris, is in San Fsancisco on his return from Siberia.

J. Morgan Clements, on his return from Mongolia, has gone to Hinan, near Canton.

D. J. Argall, of Thane, Alaska, is spending the month of December at San Diego, California.

W. J. Loring, after attending the American Mining Congress at Denver, went to Washington.

Edwin Mills and **J. F. Manning** have been examining the Mongolor mine, near Urga, in Mongolia.

E. A. Cappelen Smith has been awarded the gold medal of the Mining and Metallurgical Society of America.

H. Hardy Smith is expected in San Francisco before the end of the year on his return from London to Australia.

Robert Linton, president of the North Butte Mining Co., was in San Francisco on his way from Montana to New York.

J. Malcolm Maclaren has been appointed a member of the technical committee of the National Mining Corporation in London.

A. G. Burritt, of Salt Lake City, has been making an examination of the Eureka-Nevada mine, in New York canyon, Nevada.

F. Leslie Ransome attended the convention of the American Mining Congress at Denver, on his way to Oatman, Arizona.

Marshall D. Draper is now chief engineer to the Kotchiou Tin Trading Co. in Yunnan, China. **T. K. Li** is acting as his assistant.

Forest Rutherford has returned to New York, after spending several months in Colorado on mine examinations and milling problems.

A. W. Newberry, accompanied by **C. A. Newton,** sailed on November 27 from New York for Nicaragua, to examine the San Albino mine.

W. H. J. Brown, F. B. Keever, and **Wallace Macgregor,** of San Francisco, have been examining mining claims at Eureka, Nevada.

Rush T. Sill and **Harley A. Sill** have left for Arizona and New Mexico, where they will examine several properties, returning to Los Angeles about the first of the year.

C. S. T. Farish has resigned his position as general foreman for Backus & Johnston to accept the position of assistant mine superintendent with the Amparo Mining Co. at Etzatlan, Jalisco, Mexico.

A. W. Tucker, after sixteen months field-work for the Bureau of Mines in connection with War Minerals Relief claims, has resumed private practice in the Southern Appalachians, with an office at Salisbury, North Carolina.

H. Foster Bain was in San Francisco this week on his return from Shanghai to Washington. On November 30 he delivered an interesting address on his experiences in China before the Engineers Club.

C. M. Weld, mining engineer, **D. M. Liddell,** chemical engineer and metallurgist, and **P. H. Lazenby,** civil engineer with wide experience in public utilities, have formed a partnership for practice as consulting engineers and economists under the firm name of Weld, Liddell & Lazenby, with offices at 2 Rector street, New York.

THE METAL MARKET

METAL PRICES

San Francisco, November 30

Aluminum-dust, cents per pound	65
Antimony, cents per pound	7 50
Copper electrolytic, cents per pound	14.75
Lead, pig, cents per pound	6 00—7 00
Platinum, pure, per ounce	$85
Platinum, 10% iridium, per ounce	$125
Quicksilver, per flask of 75 lb	$55
Spelter, cents per pound	8.00
Zinc-dust, cents per pound	12 50—15 00

EASTERN METAL MARKET

(By wire from New York)

November 29.—Copper is inactive and weak. Lead is stagnant and lower. Zinc is dull and declining.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Nov. 23	73.37	47.12	Oct. 18	83.10	54.05
" 24	72.00	46.25	" 25	79.52	52.31
" 25 Holiday		47.50	Nov. 1	80.31	52.35
" 26	75.50	48.75	" 8	81.90	54.00
" 27	76.00	49.12	" 15	80.02	53.50
" 28 Sunday			" 22	76.41	49.96
" 29	71.75	46.12	" 29	73.72	48.97

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.67	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	93.66
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	83.48
May	99.50	107.23	102.69	Nov.	101.12	127.57	....
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Nov. 23	14.50	Oct. 18	17.15
" 24	14.25	" 25	15.75
" 25 Holiday		Nov. 1	15.08
" 26	14.00	" 8	15.00
" 27	14.00	" 15	14.87
" 28 Sunday		" 22	14.62
" 29	14.00	" 29	14.15

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	18.75
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	16.53
May	23.50	15.91	19.05	Nov.	26.00	20.45	....
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Nov. 23	6.00	Oct. 18	7.50
" 24	5.85	" 25	7.08
" 25 Holiday		Nov. 1	6.92
" 26	5.50	" 8	6.81
" 27	5.50	" 15	6.61
" 28 Sunday		" 22	6.44
" 29	5.50	" 29	5.67

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.76	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.76	5.24	9.22	Sept.	8.05	6.02	8.08
Apr.	6.99	5.05	8.78	Oct.	8.05	6.10	7.28
May	6.99	5.04	8.55	Nov.	8.05	6.76	..
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	60.74	July	93.00	70.11	49.29
Feb.	85.00	73.14	59.87	Aug.	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	44.43
Apr.	[illegible]	[illegible]	[illegible]	Oct.	78.82	54.82	40.47
May	100.01	72.50	54.99	Nov.	73.67	54.17	....
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery in cents per pound.

Date		Average week ending	
Nov. 23	6.40	Oct. 18	7.41
" 24	6.30	" 25	7.50
" 25 Holiday		Nov. 1	7.54
" 26	6.25	" 8	7.31
" 27	6.20	" 15	6.86
" 28 Sunday		" 22	6.66
" 29	6.10	" 29	6.25

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8.93	Sept.	9.58	7.57	7.84
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	7.50
May	7.92	6.43	8.07	Nov.	8.75	8.12	....
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Date	
Nov. 1	50 00	Nov. 16	55 00
" 9	55.00	" 23	55 00
		" 30	55.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89 00	July	120 00	100.00	88.00
Feb.	118.00	90 00	90.00	Aug.	120 00	100 00	85.00
Mch.	112.00	72 80	87 00	Sept.	120 00	102 60	75.00
Apr.	115.00	73.12	100 00	Oct.	120 00	86 00	....
May	110 00	84 80	87 00	Nov.	120 00	78 00	....
June	112.00	94 40	85 00	Dec.	115 00	95 00	....

IMPORTING GOLD FROM LONDON

Kuhn Loeb & Co. have imported nearly $65,000,000 gold this year, bought in the London open market. This is brand new gold—not like that brought over recently by reserve banks which was 'ear marked' to their credit in Bank of England and which they already counted in reserves. Although this $65,000,000 is a private importation, most of it has gone to the New York Federal Reserve bank, and, through it, into the reserve system, because Kuhn, Loeb & Co. have been selling the metal directly to the reserve institution. The importers have found this a more advantageous way of handling incoming gold. It has often meant dollars and cents to them. Both parties profit, since the reserve bank is placed in immediate position to expand credit.

While importers can get immediate credit under certain conditions by turning their gold into the Assay Office, the Government institution is not in position to render the same facilities as the reserve bank. For instance, Kuhn, Loeb & Co. have found that if a consignment of gold comes into their possession after 2:30 p.m., the Assay Office will not give them credit for the amount until the following day. Federal Reserve Bank will give them credit therefor up to a late hour in the day. On gold consignments involving several millions, the saving of a day's interest is no small consideration.

In this way the more up-to-date management of the Federal Reserve Bank, as compared with the red tape of the Government institution, is enabling the former to accumulate the yellow metal more rapidly than it would in ordinary course. The $65,000,000 gold obtained by Kuhn, Loeb & Co. this year has been a pure exchange operation, based on position of sterling in this market. The gold is product of the mines sold in the open market. Bankers cannot get gold from the Bank of England, and there is an embargo on British gold exports. But the British government has made special exemption in case of gold from the mines currently offered in the open market. This may be taken by the highest bidder, and because of the low position of New York exchange and the exchanges at certain other centres, a high premium on the market gold has ruled. At present bar-gold in London is quoted at about 118s. per ounce, compared with about 85s. normal. Formerly India and the Far East were active competitors with New York, but now New York appears to be the only bidder, after Government requirements are filled. The British Indian treasuries are always given precedent.

It is commented upon that Kuhn, Loeb & Co. should be the only New York banking house importing gold from London at present. The distinction lies less with Kuhn, Loeb & Co. than with Rothschild & Co., London, who do the actual buying and who appear especially favored in this respect. Kuhn, Loeb & Co. are merely consignees of the metal sent by Rothschild & Co. Initial deposit of the gold at reserve bank, on basis of 40% reserve, would allow for note expansion of about $160,000,000; but through ramifications of banking credit, potential credit expansion is in proportion of at least 10 to 1. Therefore Kuhn, Loeb & Co. importations have provided for a possible credit expansion of between $600,000,000 and $700,000,000.

MONEY AND EXCHANGE

Foreign quotations on November 30 are as follows:

Sterling, demand	Cable	3.50
	Demand	3 50⅜
France, checks	Cable	6.13
	Demand	6.14
Lire, checks	Demand	3.70
Marks, checks		1 50

Eastern Metal Market

New York, November 24.

Liquidation in practically all the markets continues and quotations are lower.

Demand for copper has not improved. Further offerings have depressed values to new low levels.

There is no animation in the tin market, the tone of which is easy with prices lower.

Lead is freely offered in quantity and quotations are considerably lower.

Stagnation features the zinc market, with buying and production curtailed.

Antimony joins the procession and is also lower.

IRON AND STEEL

The Steel Corporation's announcement that it would not advance its prices unless "altered conditions" made advances necessary has had no measurable effect on the steel market, and its precise intent is not yet clear, according to 'The Iron Age'. It has been understood that the corporation seriously considered advancing rail-prices, and the fact that it made large contracts for 1921 into which the price was to be written later pointed to a higher level than $47, which it has maintained since March 1919. Several independent mills that for more than a year have charged $55 and higher for rails have refused to book orders for 1921 with the proviso that the Steel Corporation prices govern, and some of these mills could not meet the Steel Corporation's price without a drastic readjustment of wages.

Current export trade in iron and steel is about one-third the volume of a few months ago. One sale of the week was of 5000 tons of structural steel to the Dutch government, made by the Steel Corporation, the price being close to 2.65c., Pittsburgh, or about $4 per ton higher than the basis for domestic business.

COPPER

The market does not improve; it goes from bad to worse, if anything, so far as prices are concerned. Consumers are still apathetic so far as large purchases are involved. There continue to be offerings by small producers and second-hands which have further depressed prices, caused by the necessity to convert metal into cash. It is understood that one or two large interests are willing to shade the 14.75c. price of the leading producers who have not thus far changed their asking price. The result of these conditions has been a recession in values to not higher than 14.50c., New York, for electrolytic copper at which level it is believed nothing less than sizable tonnages can now be obtained. For small lots from second-hands and small producers it is stated that 14.25c. can be done. We quote the market at 14.50c. for this year and 14.75 to 15c. for first quarter. When the market had receded to around 15c. a short time ago, fairly large sales were made at 15c. and 15.25c. for early and first-quarter delivery. Sales for foreign account are about the same, that is, light.

TIN

In a dull and uninteresting market the sharp slump in London on Monday of this week has been the only feature. Despite the fact that it was big, it was not followed by sellers on this side, because they regarded it as overdone or far-fetched. As a result the market here was not affected much but remained on Monday at 36c., New York, nominal, for spot Straits, or where it closed last Friday. On Monday, prices broke to £231 for spot standard, to £234 for future standard, and to £231 10s. for spot Straits, remaining yesterday, Tuesday, at practically those levels or £230 15s., £234 15s., and £231 5s., respectively. Yesterday spot Straits, New York, was again nominal but a little higher at 37c. Last week Thursday, November 18, was the only day of any trading and it was small. A little spot Straits changed hands at 37.25c. and some metal ex-steamer in the harbor at 37c. More was offered but there was no buying and competition was active for the business offered. Sales on the New York Metal Exchange in the week totaled about 75 tons, some October-November shipment going at 37.50 to 37.75c., and one 25-ton lot of Straits under the rule at 37.25c. Arrivals thus far this month have been 2580 tons with 3500 tons reported afloat.

LEAD

Late Monday another cut was made by the American Smelting & Refining Co. of ¼c., reducing its price to 6c. both New York and St. Louis. Just previous to this the outside market had reached the 6c. level. The market may be termed as very weak, bordering on demoralization. While 6c. is the quotation it is hinted that inquiries involving large quantities could bring a lower price. These are free offerings of the metal in large quantities and the falling off in consumption is drastic and pointed to as the cause of the present tendency of the market. Because the low price in London and the possibility of imports, the New York price of the leading interest is the same as at St. Louis. At present value of exchange, the metal in London has a value of around 4.55c. per pound.

ZINC

The market has not improved but quotations have declined. Prime Western for early delivery is quoted at 6c., St. Louis, or 6.40 to 6.50c., New York, but demand is almost nothing. Galvanizers seem well supplied in relation to their orders for sheets and are buying only what they need here and there. There has been a slump in brass operations. The offerings of zinc come from interests needing the cash and from those operators who are working off ore piles or old stocks. The tendency to curtail output is marked. It is intimated that the industry as a whole is operating well under 50% of capacity with some producers down to a basis of 25% capacity.

ANTIMONY

Demand is light and unsatisfactory and carload or wholesale lots for spot or early delivery can be obtained at 5.87½c., New York, duty paid.

ALUMINUM

Virgin metal, 98 to 99%, is unchanged at 32.90c. f.o.b. producer's plant from the leading interest, but other sellers are quoting 27.50 to 28.50c., New York, for wholesale lots for early delivery.

ORES

Tungsten: There has been no test of the market. Prices are therefore nominal at $4 per unit for Chinese ore and $5 per unit for Bolivian.

Ferro-tungsten is quoted unchanged at 90c. per pound of contained tungsten in guaranteed lump and at 70c. not guaranteed. The powdered form is quoted at 78 to 85 cents.

Molybdenum: Quotations continue normal with sellers' ideas at 60c. per pound of MoS_2 in regular concentrate and buyers' ideas of values at 50 cents.

Manganese: The market for high-grade ore is dead with quotations nominal at 45 to 50c. per unit, seaboard.

Manganese-Iron Alloys: American makers of ferro-manganese have reduced their asking price to $150, freight allowed, which compares with $170, basis, seaboard, formerly. The British price is still $170, seaboard, but the development of any business could probably bring down this price. Spiegeleisen, 20%, is easier at $62.50, furnace, but there is no demand.

Book Reviews

Elements of Descriptive Geometry. By George F. Blessing and Lewis F. Darling. 200 pp., ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $2.50.

The material for this book was prepared in the main while the authors were teaching machine design at Cornell University, and the book is designed for, and arranged as, a class textbook. No human power could make the subject of descriptive geometry anything but difficult for the average student to grasp, but the authors appear to have done as well as possible under the circumstances.

Gold. Its Place in the Economy of Mankind. By Benjamin White. 128 pp., ill., index. Sir Isaac Pitman & Sons, Ltd., New York and London. For sale by 'Mining and Scientific Press'. Price, $1.

This is one of fifty small books that describe the manufacture and use of every-day commodities, including, for instance, soap, tobacco, copper, and automobiles. The first chapter is captioned, 'Its Appreciation, Ancient and Modern', Then come several chapters on production, use in coinage, and movement of gold over the world. A final chapter, 'Gold and the Great War', gives an excellent resume of the financial difficulties brought about by the War and clearly states some of the problems of 'gold currency-reserves'. It is a good popular book.

Geology of the Non-Metallic Deposits Other Than Silicates. Vol. I. Principles of Salt Deposition. By Amadeus W. Grabau. 435 pp., ill. Published by the McGraw-Hill Book Co., New York. For sale by the 'Mining and Scientific Press'. Price, $5.

"This book," says the author in his preface, "is essentially a treatise on applied stratigraphy." It is a handbook on the geology of salts, using the term in its broad sense, to include nitrates, phosphates, borates, and similar deposits, that is, non-metallic minerals used in human industry. It starts with a chapter on the chemical principles underlying the methods by which such deposits are formed, and classifies them. Then follows the characterization of minerals and an account of their distribution in nature. The author is recognized as an authority on the subject; he is a scholar and writes clearly. The book should prove useful and welcome.

Political and Commercial Geology and the World's Mineral Resources. By J. E. Spurr. 544 pp., ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $5.

The purpose of this book is "to shed light upon the vast importance of commercial control of raw material" to governments. Commencing with petroleum, coal, and iron, the useful minerals are considered in successive chapters from the following points of view: uses, geological and geographical distribution, political control, and commercial control. One group includes the metals used as alloys for hardening and toughening steel; a second group includes the major metals other than iron, as well as some important non-metallic minerals such as magnesite, graphite, and asbestos; the third is that of the fertilizer minerals; and the last deals with precious metals, which in the final analyses are not so important as the others from the standpoint of national safety—which is in fact the motive for a careful study of mineral resources of the world. Each chapter is handled by a specialist and each summarizes the present-day knowledge regarding the distribution and utility of a particular mineral. Mr. Spurr concludes the book with a chapter, 'Who Owns the Earth?' which gives the salient features of the separate chapters. The book is interesting; it is instructive.

Laboratory Manual of Testing Materials. By William Kendrick Hatt and H. H. Scofield. Second edition. 169 pp., ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $2.

The first edition of this book appeared seven years ago. The principal changes in the second edition are in bringing the material up to date, particularly the division relating to cement and concrete. The authors are both professors of civil engineering, one at Purdue, and the other at Cornell University. The book includes a general discussion of testing-methods, a description of the various types of testing-machines, and directions for performing the principal kinds of physical tests on the more important engineering materials. There is also an appendix containing skeleton specifications for various materials, and directions for making metallographic examinations.

American Lubricants. By L. B. Lockhart. 330 pp., ill., index. The Chemical Publishing Co., Easton, Pennsylvania. For sale by 'Mining and Scientific Press'. Price, $4.

As the title-page states, this book is written from the standpoint of the consumer and deals with the use and the analysis of lubricants, and only incidentally with their manufacture. After a brief discussion of the production and refining of petroleum, the subject of friction and lubrication is considered. Then come several chapters each dealing with the lubrication of some particular kind of machinery. Physical and chemical tests for lubricating oils and greases are then discussed. The next two chapters are devoted to animal and vegetal oils and the testing of the same. Then come several chapters each dealing with specifications for some particular kind of lubricating oil or grease. The last forty pages of the book are devoted to specifications and tests for other petroleum products than lubricants. The purchaser or the user of lubricating oils will find much that is useful in the book.

The Mineral Industry, 1919. Vol. XXVIII. Edited by G. A. Roush. 902 pp., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press'. Price, $10.

This twenty-eighth volume of 'Mineral Industry' lives up to the standard established by its predecessors. The book is designed as a permanent and compact record of the year's progress in mining and metallurgy; it comprehends three distinct phases of the industry, namely, statistics of production, progress in technology, and the market or commercial features. The statistics are important but they are not the only valuable part of the work. Each section is in charge of an editor who is a specialist in the production of the particular commodity being discussed, so that the material presented is verified as far as possible by one who is an authority on the subject. The scope of the book is international, yet it is primarily an American product and most of the data deals with American production. Sources of information are the U. S. Geological Survey, the U. S. Bureau of Mines, and the Department of Commerce; the technical journals of this country and others; and to some extent private communications. No attempt has been made to include all minerals; indeed it may be that, in the opinion of some, the space devoted to some of the less important products could to advantage be used in greater elaboration of the technical discussion of the more prominent metals. The book is full of information that cannot be found elsewhere without an amount of searching disproportionate to the cost of this volume; it is an invaluable book of reference with the rare merit of being as nearly up to date as is reasonably possible.

INFORMATION FURNISHED BY MANUFACTURERS

MOTOR-TRUCKS V. HORSES

In discussing the question of horse-haulage v. motor-truck, W. A. Carpenter, of the Acme Motor Truck Co., Cadillac, Michigan, says: While much has been said upon this subject, the following comparison will illustrate in a striking way the difference between the two methods, and may present the matter in a different light from that in which you have seen it before.

The average two-horse team will haul two tons over the average road, at a speed not greater than three miles per hour. Allowing one hour for the noonday stop, and another hour for loading, unloading, resting on grades, and miscellaneous delays, it is safe to say that the team will in a ten-hour day cover not more than 24 miles.

Now for the truck's side: No preliminary work in the morning is necessary, with the exception of a few moments inspection every morning, desirable in any piece of machinery. Allow the same two hours lost time each day for truck as allowed for team, though the hour allowed for such delays will be confined to loading and the greater part of this time eliminated. At the close of the first day the truck will be 136 miles from place of starting (remember the team has made but 24 miles). At the close of 300 days, truck will be 40,800 miles from the starting point, though during the 300 days the team has covered only 7200 miles. In other words the truck has carried two tons 33,600 miles farther than the team did in the same length of time. Keep this up for say five years, if the horses are able to work steadily 300 days per year for five years, and we find the truck 168,000 miles ahead of the team. Counting feed, care and up-keep of team, harness and wagon, the cost of operation and maintenance is about the same for truck as for team, at least not much more. The investment, of course, is much greater with the truck than with team, but as will be seen from above, the results do not compare favorably to the horse.

ANNUAL DRILLING CONTEST AT BAXTER SPRINGS

Down in Baxter Springs, Kansas, in the Joplin district, the feature of the annual fall festival is a rock-drilling contest. The contest was held this year on October 20. Teams are required by the rules of this contest to set up tripods; connect hose to drill; drill hole clear through rock; tear down drill; disconnect hose; loosen bolts; and place hose, steel, drill, and tripod back in position where found.

The rock used last year was a block of Carthage marble five feet square, marked off into 12 square spaces, one space being reserved for each drilling team, while this year a block of concrete six feet thick and filled with boulders, was used. Miles and Vickery, who carried off the first prize last year with the Waugh turbo drill, were just one second behind Abbott and Mitchell, the team that won the first prize this year. Both teams operated the Waugh turbo drill, as did also Santon and Cox, winners of the third prize in this year's contest.

The drilling time for the first three teams including setting-up, tearing-down, etc., was as follows: first, 4 min. 26½ sec.; second, 4 min. 27½ sec.; third, 5 min. 4½ sec. The nearest competitor of the three winning teams, operating another make of drill, completed their hole in 7 min. 4½ seconds. Last year the winning time in this contest was 5 min. 16 seconds.

COMMERCIAL PARAGRAPHS

Henry F. Pratt has been appointed mid-western sales-manager of the **Taylor-Wharton Iron & Steel Co.** and its subsidiaries, with offices at 502 Denham Bdg., Denver, Colorado.

A handsome new catalogue has just been issued by the **Worthington Pump & Machinery Corporation** illustrating and describing Worthington marine pumps and auxiliaries. The catalogue, No. BK-3000, consists of 125 pages of descriptive matter and illustrations, and those engaged in marine work generally will find it a comprehensive and useful publication. A copy can be obtained from the company's nearest branch office.

Bulletin No. 48704A, 'G-E Insulating Compounds', issued by the **General Electric Company,** presents the principal characteristics and effective adaptations of the wide field of electric insulating and coating materials. Imperative factors in selection are: electrical properties, dielectric strength, insulation resistance, breakdown resistance under high frequency or oscillatory discharge and temperature-change resistance; also physical properties, tensile or compressive strength, rigidity or flexibility and high or low heat-conductivity; and finaly chemical properties, form and composition of the material. This is essentially a work of research and experience for which the extensive Research Laboratories and magnitude of activities of the company combine to perfect such products and their methods of utilization.

The Dodge Sales & Engineering Co., of Mishawaka, Indiana, announces the publication of a catalogue on 'Dodge Standardized Elevators and Conveyors'. The catalogue is one of the most comprehensive that has ever been issued covering the above subjects and should constitute a text-book. The complete tables of data incorporated in the catalogue represents an immense amount of work on the part of the Dodge Sales & Engineering Co. The tables used in this catalogue are based on maximum conditions for the different carrying parts, rather than on the assumption of conditions and the working out of a design for those particular conditions. An interesting feature is the simple manner in which designs involving gearing are developed, whereby almost any drive whether for a conveyor, elevator, or other speed reduction can be picked out of tables; pitches, numbers of teeth, and shaft sizes are likewise given. All details are thus solved without any complicated calculations. The catalogue is standard Dodge size, 6 by 9 in., and is printed on fine enamel stock paper, the whole containing 160 pages and about 150 illustrations. The catalogue has been in preparation for more than a year and a half and no pains or expense has been spared to make it comprehensive in every detail. The catalogue was prepared under the direction of A. O. Gates, of the Dodge Sales & Engineering Co., whose method of design of bucket-elevators has resulted in greatly improved elevator practice in plants in all parts of the world. According to present plans the new catalogue will be ready for distribution on or about December 1.

T. A. RICKARD, - - - - Editor

ANYBODY who has traveled recently across country will appreciate the remark of the man who was asked, "How's the railroad situation?", and answered, "About the same. Congestion in the freight-cars and indigestion in the dining-cars". And what is worse, the price of the indigestion is piratically excessive.

EXTRAVAGANCE is indicated unmistakably by the fact that during the fiscal year 1920 the importation of diamonds into the United States was nearly double in value that of the previous year and more than three times the total in 1918. More than 90% of the imports came from South Africa, from the mines of Kimberley and the adjacent region.

REFERRING to the stimulation of gold mining, we note that the Governor of Western Australia speaks favorably of the prospecting done by returned soldiers. They have been aided by the Mines Department and the Repatriation Department, the result being an "unprecedented activity in prospecting throughout the eastern goldfields". Here is an obvious method for assisting our demobilized soldiers, if out of work. We suggested the plan more than a year ago.

AMONG recent statements that one may call "important, if true" is the announcement of an invention by Mr. William L. Emmet of the General Electric Company whereby he is enabled by means of a mercury-vapor boiler and turbine "to cut the cost of producing electric power and light in half". This invention is said to have been "perfected". The only change that need be made in existing plants is in boilers. It looks like a body-blow at H. C. L., for if the cost of power can be halved, the cost of manufacturing will be reduced greatly. We look forward to further information on the subject.

THE 'Financial Times', of London, remarks that there is nothing to justify the high premium at which Minerals Separation shares are quoted, namely, £10¾ for the £1 shares. For the fiscal year just ended a dividend of 5 shillings has been distributed, as compared with 10 shillings in 1918 and 1917. However, our British contemporary says that "the market attaches much speculative interest to the company's new process". This is a process "for combining pulverized coal and oil in a stabilized form, which produces a valuable liquid fuel". Minerals Separation owns the patent rights to this process all over the world except in Japan and the American continent. Japan does not grant patents, and the rights on the American continent, presumably, have been transferred to the Minerals Separation North American Corporation in New York.

A DISPATCH from Cananea states that the Cananea Consolidated Copper Company has posted notices announcing the suspension of all operations at its mines and smelter in Northern Sonora. This action will throw 2000 men out of work and will indirectly affect many more; indeed, an extremely large territory is dependent directly on the Cananea Consolidated enterprise. The reasons assigned are the long-standing threat of labor troubles and the burdensome taxes imposed by the Mexican government on the production of copper. The underlying reason obviously is the condition of the world's market for copper. It is stated that Señor Adolfo De la Huerta, former provisional President, has been designated by the Mexican government to undertake an adjustment of the difficulty. He has the reputation of being a fair man, and quick-witted; therefore we feel assured that he will recognize the importance at this time of bringing about a settlement that will be just to all concerned.

OUR friends in London are nothing if not consistent; despite the protests made from this side against the bestowal of the gold medal of the Institution of Mining and Metallurgy on Mr. H. L. Sulman, the same engineering society has gone out of its way to award to the same gentleman the gold medal and premium of the Consolidated Gold Fields of South Africa, namely, the medal and premium given annually by that well known company for bestowal by the Council of the Institution. We need not repeat the objection to this selection of Mr. Sulman for such honors at this time, when to the mining profession in the United States he is known only as the patentee and metallurgist identified with Minerals Separation, a corporation that has made itself extremely unpleasant to so many engaged in our mining industry. The award of this second medal, like the first, is "for his paper, 'A Contribution to the Study of Flotation' ". In his letter to 'The Mining Magazine' of May last, Mr. Sulman stated that his partner, Mr. Hugh F. K. Picard, "had no part in the preparation of the paper nor in the research which led to its publication. Neither was he

co-author with me of the original notes referred to, for the sufficient fact of his absence from England during a large part of the time that the research was being conducted. It is true that during part of this time I had the benefit of his help, but he disclaims entirely co-authorship of the notes''. Then Mr. Picard is unusually self-extinguishing, for we have before us as we write a copy, duly attested by a notary public, of the treatise mentioned, as submitted in the Miami litigation with Minerals Separation. On the cover it bears the following title: ''The Theory of Concentration Processes Involving Surface-Tension', by H. Livingstone Sulman, F.I.C., M.I.M.M., and Hugh Kirkpatrick Picard, A.R.S.M., M.I.M.M.'' Of course, those who award medals have a right to give them to whosoever they please, but in this case the second medal might, it seems to us, have been bestowed upon Mr. Picard. He is a good fellow and a first-class metallurgist, anyhow.

WE note a small item in an English paper, in which the writer condoles with the Cornish miners who have been discharged from their work in the tin mines; it is estimated that in all some 1300 men have been released from Dolcoath, Grenville, and Tincroft. That they were hard-working citizens and splendid miners there is no question, but that they require sympathy, at least the younger of them, is doubtful. For some of them the cloud has acquired a silver lining, since we learn from a recent dispatch that 200 miners from Cornwall have arrived and gone to work in the silver mines of Cobalt where the shortage of competent men has been felt for many months. They will earn higher wages and probably in a few years will be better off in every way than if they had stayed at home. Cobalt and Canada will benefit by the acquisition of miners who inherited their mining sense through generations, and men who will be a credit to their adopted country. There is room here in the United States for many times what Cornwall can spare.

"PARIS has struck gold'', says a sensational dispatch in a recent morning paper. The discovery is said to have been made at Gief, ten miles from the city of pleasure. It is not a placer deposit but a two-foot vein of gold-bearing quartz, which was cut 80 feet below the surface. It is not clear what the diggers were seeking so far underground when they found gold, but it is stated that the news attracted so large a crowd of amateur prospectors that a large force of police had to be sent to the locality. Gold was found recently in South San Francisco, according to the local newspapers, and no more was heard of it. The later story from Paris is probably a canard, like many others of the same kind. Gold is widely distributed in nature and has been found in every kind of rock; France used to have a number of productive gold mines years ago, notably the La Belliere, Chatelet, La Lucette, Salsigne, and Villaniere. In 1909 the La Belliere made a profit of two million francs. In 1910 the output was 8500 tons of ore yielding 38,733 ounces of gold. 'The Mining Magazine' of March 1911 contained an article by Mr. Thomas T. Read on this enterprise. The mine is near Nantes on the Loire, in La Vendée, a region in which the Romans mined extensively for gold during their occupation of Gaul. Augustus derived a large tribute in precious metals from the Gauls and it is related that in 15 B.C. the Roman procurator Licinus took the man who was president of the republic and the adopted son of Julius Caesar to a large room full of gold and silver that had been extorted from the natives for the support of the government on the Tiber. At Bourg d'Oisans, in the Isère, is an old gold mine that was worked by the Greeks, the Romans, and the Saracens. It is called La Gardette and was operated by the Count of Provence in 1783 and by two Englishmen in 1862. These notes suggest that a gold mine in France is nothing unusual, but a profitable gold mine close to Paris would be a phenomenon indeed, and altogether subversive of accepted ideas.

Speakers and Speeches

Fluency is a danger, loquacity is a bore, garrulity is a pestilence. Anybody familiar with the proceedings of a convention, such as the recent meeting of the American Mining Congress, is likely to ask why the speaking is not under better control. So many sessions are spoiled by the egoism of some individual wholly oblivious of the fact that there are others on the program. The worst type, of course, is the person having an easy flow of speech and a paucity of ideas; the few real thoughts he has can be seen floating about in his mind, like carp in a pond. There is the man who undertakes to discuss a subject needing scientific precision and brings to bear upon it a large command of inaccurate language, by the use of which he involves his hearers in a mental dust-storm. There are those with the gift of speaking far beyond anything worth while that they have to say. There are others who deliver their opinions like Milton's angels, whose didactic speeches were received with respect and concluded with gratification—to all concerned. All this we write not with malice but with a quiet smile. At Denver we were not victimized to any acute degree, but some incidents of that convention provoke the discussion of a subject that is of real importance to gatherings of the same kind. For instance, a session begins a quarter of an hour late, so that, as between 10 o'clock and noon, there remains an hour and three-quarters. Three, or perhaps four, speakers are listed. One of them reads a paper that consumes an hour, leaving only 45 minutes for the others. The first paper may be a good one, so good indeed that the whole session might better have been devoted to the reading and discussion of it, but the knowledge that others are to come makes one impatient, with the consciousness that the speaker is exceeding his limit; indeed, only a trained speaker and one discoursing on an unusually interesting subject can hold an audience for an hour. Usually the effort tires his hearers and spoils them for subsequent papers. Papers that are read, of course, are less easy to follow than speeches, because the latter are couched in shorter, and more natural sen-

tences. Obviously if a session of two hours, or more, is to be devoted to one subject and to be divided among a number of speakers or readers of papers, it would be best to tell each one how much time is allotted to him, thereby compelling each one to omit or curtail parts of his paper beforehand, so that it might comply with this necessarily drastic method for saving time and patience. Much, of course, depends upon the chairman, but most chairmen are either too inexperienced or too amiable to exercise their legitimate authority, especially when it ought to be directed against the more verbose speakers, who, not infrequently, are persons of some consequence, so accustomed to speaking in public that they find it easy to do so and in the exercise of their facility forget to curb it. At the Mining Congress banquet the toastmaster had a traffic signal, showing 'GO' on one side and 'STOP' on the other, and he used it in fun once or twice, ineffectually. An hour-glass signal, adjusted to the exact time given to each speaker, might be placed in front of him in full view of the audience. That might be an effective reminder, but it would be useless as a check unless applied strictly. Another means for abating a public nuisance might be borrowed from the vaudeville theatre. Once in a while it is the custom to have an 'amateur night', when almost anybody having histrionic or dithyrambic ambitions is given a chance to show what he can do. Under such circumstances, naturally, some device for checking the exuberance of virtuosity is imperative; so the manager employs the 'hook'. When the audience becomes tired of any individual performance, there are cries, sometimes concerted, of "Get the hook". Thereupon a wire hook or loop is extended from the wings so as to drop securely around the body of the victim and hale him hence, amid the jeers and laughter of the audience. Joking apart, it is obvious to anyone familiar with conventions and their antics that some method of assisting the chairman in regulating the proceedings would be a boon and a blessing. As to the speechifying at dinners and banquets, that is being disciplined already, in this country, by the prevailing aridity. Prohibition is a veritable Procrustes for abbreviating speeches. In days when stimulating liquors assuaged the pain inflicted by bores it was possible to listen to long speeches with some approach to resignation, if not oblivion, but now that we are denied any solace but soup and soda-water it is absolutely necessary to make speeches that are crisp and short, and not too many even of them. The idea of talking solemnly on a serious subject is entirely foreign to the spirit that brings men together at dinner, yet attempts at elaborate discourses are still made occasionally by pachydermatous persons. A dinner must be eupeptic, and to be that the things that are said should be as easily assimilated as those that are eaten are comfortably digested. In these days the lack of wine makes us sensitive to the gastronomic imperfections of public dinners, therefore all the greater is the need for utterances that do not provoke mental dyspepsia. The standard of the speeches on such occasions is going to be much more exacting, and the verbal meanderings of self-complacent pseudo-orators are going to be taboo. At least we hope so. If prohibition induces saner ideas on these matters we shall have reason to be grateful to the 18th Amendment; if not, we shall have two reasons for being bad-tempered. In conclusion we quote the suggestion of a distinguished Judge that most people are so fond of talking that they lavish much praise on silence in others, as poverty is lauded as a virtue because every one wants to be rich.

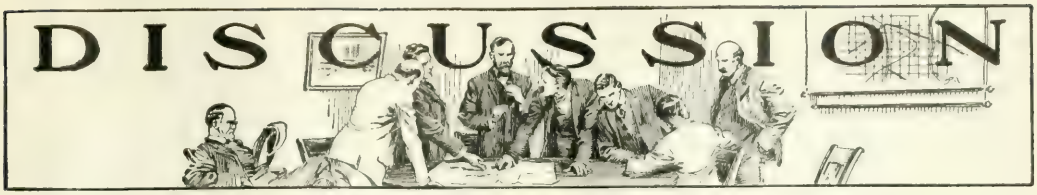
Industrial Relations

We are glad that we published the three articles by Mr. W. R. Ingalls, on the labor question, because, among other reasons, they have elicited discussion by Mr. C. V. Corless, whose thoughtful contribution we publish on another page of this issue. Dr. Corless is well known for his interest in the subject of industrial relations; he has contributed several valuable essays to the transactions of the Canadian Mining Institute; he is an earnest student of the question, as his latest utterance proves. It is well that the other side of the controversy—for unfortunately it is that—should be presented. Mr. Ingalls represents what is called the reactionary view; his sympathies are capitalistic; in economics he is a Tory. On the other hand, Dr. Corless represents the progressive view; his sympathies are with the workers; in economics he is a Liberal, if not a Radical. Men of both types are needed for the purpose of establishing a sane balance of ideas, although, of course, we hope and believe that the liberal view will prevail. This view takes for granted that, as Dr. Corless says, "we are dealing not with materials and machines but with men". To make it more precise we would place an 'only' after "machines". In order to produce the maximum of useful effect it is necessary that the men as well as the machines become the object of economic solicitude, which means that as we recognize the machines to be made of metal, so we shall recognize continually that the men are human beings like ourselves, with feelings, as well as hopes and ambitions, that are at least as delicate as the fine edges or the intricate wheels of the machines they use. Undoubtedly it is desirable to develop a sense of personal achievement among the workers, that is, to stimulate an interest in their task, lifting it thereby from drudgery to accomplishment. We have been reading the book by Mr. Whiting Williams entitled, 'What's on the Worker's Mind'. The author went to work as a laborer in a number of plants successively, including a rolling-mill, a foundry, a railroad shop, a coal mine, an iron mine, and a dockyard. He came into intimate contact with many classes of workmen under conditions that enabled him to find out how they were treated, how they felt, and what they wanted. This book ought to be read by everyone interested in human economics; it gives genuine first-hand information. In many instances he found that no arrangement existed for giving proper instruction to the greenhorn; hence, of course, much discomfort to him, and with it a loss of self-respect, besides the inevitable loss of efficiency. A few words of instruction concerning the work to be done would elimin-

ate the need for the foreman whose only word is an oath. Such instruction would save the money now spent in having a boss on hand every minute to prevent blunders. "Most of the workers", says Mr. Williams, "are surprisingly anxious to feel their job important and respectable". It is rarely that the men understand the meaning of the work they are doing or the specific part it plays in the operations as a whole. One reason why they remain ignorant is because a large proportion of the bosses are aliens unable to speak our language. A knowledge of the Slavic tongue is needed by a young American working in the rolling-mills of Pennsylvania! The force consists of a weird mixture of intensely foreign foreigners, who have learned but little English beyond the coarsest expletives. To many men it is a greater satisfaction to do their work in their own way, for later inspection, than to have a foreign boss cursing them every time they make a false move. Evidently these people ought to be taught our language or we ought to learn theirs, instead of both sides being limited to the use of profanity. The tonnage-men in the coal mines, that is, those working on contract, seem to have the best of it, in that they are on their own initiative and are paid the immediate value of their own efforts. In short, a man must feel the dignity of his job if he is to do well, instead of having an ignorant foreman who assumes that the entire dignity of the job resides in himself. So we come again to the conclusion that much of the inefficiency and unhappiness of manual labor is due to the bad selection of foremen, who, of course, serve as the connecting link between the management and the men. By the treatment a man gets from his immediate boss he judges the 'higher ups'.

Another remark by Dr. Corless appeals to us, namely, the tendency to ascribe too large a part of any great economic success to one person. It is easier to envisage the success of an individual than that of a group of men or an organization; besides it is more romantic to have a hero, on whose head the chaplet of palm-leaves can be placed gracefully. Moreover, the irresponsible journalism of the day likes to dwell upon the sensational aspect of any industrial enterprise, and it becomes more sensational when ascribed to an individual whose portrait can be presented in garish verbal colors than when credited to a combination either of favorable circumstances or of capable co-workers. Such men as Messrs. Rockefeller, Carnegie, and Schwab, the types of successful captains of industry, are poor things if examined closely and critically, but they serve to epitomize the highly organized activities of a cohort of clever and resourceful men, most of whom were willing to accept their leader as the expression of their own aggregate endeavor. In their willingness to subordinate their own prominence or distinction in achieving the purpose of their work they exhibited the highest form of what we call civilization, which is based upon the subordination of self-assertion for the sake of the community. Dr. Corless says a true thing when he asserts that similar co-operation is needed between all those engaged in industry. "The most profound problem in industry arises from the search for a method of organization that will result in enlisting in its service the highest degree of brain-power, that is, intelligence, good-will, and will-power, of all those engaged in it." Capital includes many things besides money, as for example, the trained technique of an engineer or the trained muscles of a good workman. So long as we recognize the right and the desirability of transmitting property from father to son, or to whomever the possessor of it may see fit, we shall have to realize that the employer brings to industry something more than either his own brains or the muscles of his workmen, or the muscles and brains of both. The accumulated effort of a man or of his predecessors is turned into a reservoir of capital, and unless he can have the last word in the disposal of it, subject to taxation by the State under the protection of which it was accumulated, he will be deterred from extra effort. In short, so long as the reward of industrial initiative is to be recognized in the form of accumulated profit, it will be impracticable to divide the control of enterprise on any basis of equality with the workers who do not contribute to the monetary capital without the aid of which the enterprise could not have come into being. The Soviet system is based on the fallacy that capital can be rendered unfruitful without killing industrial development; on the contrary, it is the reservoir of stored energy from which comes the power to start and to develop the beneficent activities of our industrial civilization.

Another letter on a different phase of the same subject comes to us also from Canada. Mr. F. J. Bourne has the courage of his convictions and gives one the impression of sincerity, without which any discussion of this kind is a mere tinkling of cymbals. His contribution is prompted by the thoughtful letter from Mr. Sam Lewisohn appearing in our issue of November 6, but he takes a less cheerful view, emphasizing the recalcitrancy of organized labor. Much that he says is true, although unpleasant; for instance, that labor-unionism is a trust to raise wages just as combinations of corporations, despite the law, continue to operate as trusts to raise the prices of commodities. The story of sugar, shoes, and paper during the last two or three years is eloquent on that score. Of course, as he says, it is easy when prices are rising to give employees a share of the profit, but when the economic pendulum swings the other way there is no suggestion of decreasing wages with a view to assisting the employer. The sliding scale refuses to operate both ways. The sense of fair play is undeveloped for one thing; another is that wage-earners live in such a hand-to-mouth way that they cannot reciprocate the action of their capitalistic employers. Mr. Bourne asserts that the humane method in dealing with labor has failed; he thinks that industrial relations must be placed on a purely warlike basis; both sides becoming so organized that they can deal with each other collectively. We commend the book by Mr. Williams, in which he will find many proofs of the fact that the human factor continues to operate in many curious ways. In the recognition of it, plus fair play, lies the best hope of solving the complex problem of industrial relations.



Labor the Holder of the Nation's Wealth

The Editor:

Sir—In recent issues of your paper you have repeated, from 'The Annalist', a lengthy discussion by W. R. Ingalls which, though it contains few conclusions that are new, indicates that his riper studies have served to confirm his economic views already expressed through various mediums widely read by mining engineers. His carefully compiled data and the precisely expressed conclusions drawn from them make this essay, as well as the author's former papers on kindred subjects, valuable contributions to current economic and social literature. The accuracy, clearness, and precision of statement of the trained and scholarly editor, shown in his lucid discussion of the difficult and complex subject of the division of the national income, add to the pleasure and profit of the reader.

If, therefore, criticism is offered expressing disapproval of some of the views expressed or implied in his essay, such unfavorable comment does not arise from lack of appreciation of it as a discussion of economic facts and conclusions. It is rather his implied attitude toward the most burning social and economic question of the day, the problem of industrial relations, that appears to me to be regrettable. And this strained situation between labor and capital can never be bettered by adopting the harsh tone of superiority which appears to be displayed in such statements as the following: "If people can get into their heads the idea of the division of goods instead of the division of dollars they may become less extravagant in the use of goods and more fruitful in the production of them. The evils of the time and their corrective are condensed in this formula." Regarding the latter generalization, few will be prepared to accept so sweeping a statement. Some of the evils of the time may be "condensed in this formula", but undoubtedly many are not. It is this tactless air of arrogance and finality which, I fear, may quite unintentionally do harm by intensifying the feeling of antagonism already existing.

Let us grant, for purposes of argument, that his estimate as to the distribution of the national income is substantially correct and that he is correct in ascribing the cause of the worldwide unrest to "the desire of the wage-earner for a larger share of the product of industry"; and let us grant further the inevitable corollary of these two admissions, namely, that this desire can be fulfilled and the unrest lessened only by increasing the divisible national income of economic goods and services, which implies increasing the efficiency of the workers. The question then instantly resolves itself into one not of facts but of ways and means. In modern large-scale industry these ways and means are largely, if not mainly, questions of organization. We are dealing not with materials and machines but with men. These men have like feelings and intelligence to ourselves; they will contribute their best to industry only when this fact is fully recognized in the method of organization and the spirit underlying it. If the method and spirit of industrial organization is such as fully to recognize their feelings and intelligence, if the organization is so designed as to allow them to share reasonably in such responsibilities and information as intimately concern their own welfare, if it is so thought out as to cause them to be personally interested in what they are doing, to yield them a reasonable sense of personal achievement, and to convince them that they will share fairly in any increase of product resulting from their increased effort, there will be the strongest possible incentive by increase of effort to fulfil their natural desire for a larger share of the product. But intelligent workmen have a right to see for themselves whether the division is just or not. In future they will no more be inclined to accept statements as to the proper and just division of income, whether national or of any given industry, without having such knowledge as will be convincing, than are other classes of men. This does not mean that every workman will understand every detail any more than it implies similar knowledge on the part of every shareholder in a business enterprise. But it does mean that the workmen's representatives, equally with the shareholder's representatives, will be fully informed, will share in the responsibility of shaping the conditions under which the industry is carried on, and will have a say in the division of the product. Statements and arguments regarding the division of either national or corporation income, made with the apparent purpose of those given by Mr. Ingalls, will almost certainly not tend to lessen the existing suspicion. The reason is that workmen's representatives under existing industrial conditions have not such access to the necessary original facts and data as would really convince them. Though I recognize the difficulties to be surmounted, perhaps as fully as any other person in a responsible position in industry, I can see no ultimate way out of the present difficulty other than by fully and frankly sharing the responsibilities and information with labor.

Those who are making a close study of the evolution of modern industry can see the movement in this direction going on under their eyes. Scarcely a month goes by in which we do not learn of one or more firms adopting

the representative principle in whole or in part. It is, of course, generally advisable to adopt it progressively. This gradual increase in responsibility is the only known successful method of educating men to bear their share of it. The carrying of responsibility will prove here, as experience shows it always to have proven in other aspects of life, to have a very sobering effect.

"The economists of the coolly calculating school", who pride themselves on their want of idealism and who view their coolly calculated conclusions in the "cold and sterile" light of pure intellectuality, are not more fully aware of the truth of such axioms as that "people cannot divide among themselves more than they have got" and sundry other gems of wisdom, than are other students of economics, engaged in industry, who recognize also the bearing on the industrial problem of a number of other sciences equally relevant to its solution. The latter group probably differ from the former not so much in belief in, or attempt to reach, the economically impossible (as Mr. Ingalls appears to believe) as in their practical idealism leading to the belief that, if all the elements of the problem, including the psychological and ethical as well as the economic, are properly considered, a way out of the present industrial deadlock can be found. They believe too that the presentation of economic discussions in the manner and with the apparent purpose of his essay is likely rather to increase than to lessen the difficulty of solving the present deadlock; in other words, that such manner and apparent purpose are psychological and tactical blunders, in view of the difficult and delicate situation already existing.

Mr. Ingalls makes large assumptions as to the share of the product of unusually successful industries due to "Capital" and "Mind". The "directing mind" that conceives and initiates a successful enterprise is, aside from heredity, merely the end-product of educational and other social influences and opportunities, tracing their roots to the very beginning of civilization. The good fortune (in the form of environment for which the industrial leader can in no way claim credit) which has made it possible for him to develop his ability effectively, is in itself a social obligation for which his successful personal efforts should be considered in a large part a return. Aside from this personal effectiveness, it is worth while to consider briefly his merit in relation to the enterprise. Let us illustrate this, as does Mr. Ingalls, by reference to the successful exploitation of any one of the large Western 'porphyries'. Here again, necessary types of machinery, methods of concentration, technique of construction, and operation of cheap and large-scale reverberatory smelting and converting plants, were ready to hand, the end-products of the technical contributions of large numbers of mechanical, metallurgical, and other technical ancestors. And even when the conception that mentally pieced all these factors together began to be realized, the actual bringing of them together was due to the loyal co-operation of many who were willing to bring to bear on the problem their ability and training both in brain and brawn. No one knows better than Mr. Ingalls that not only conception is needed but also daring, and that sometimes the daring wins—and, alas, sometimes it does not. But our tendency to hero-worship causes us generally to ascribe far too large a part of any great success to some one person.

No, mind or brain-power, in relation to any large enterprise, is not concentrated in one, or even in a few, individuals, as Mr. Ingalls would lead us to believe. It is widely distributed. Labor and mind in industry are not separable *in fact*, though they may abstractedly be separated *in thought*. They are united, in variable proportion, in every individual engaged in industry. Probably the most profound problem in industry arises from the search for a method of organization that will result in enlisting in its service the highest degree of brain-power—intelligence, good-will, and will-power—of all those engaged in it. I can find nothing in any of Mr. Ingalls' discussions looking in this direction. He appears to me to have a quite unwarrantable view of the relative importance of the "directing mind" of the industrial leader as compared with that of the many minds who in varying degrees, directly and indirectly, contribute equally essentially to the success of any large enterprise. There is nothing in leadership that should cause arrogance; quite the contrary; leadership is largely the result of accident.

Again, the author appears at times to confuse the ideas 'Capital' and 'Capitalist'. Capital remains, and will always remain, no matter how wide or how equal the distribution. If every worker should tomorrow by his own energy and thrift become an industrial share-owner or capitalist, the world's capital, its means of production, would not be altered by the change in ownership. But it would have a steadying effect on industry and society in general, and it would result in greatly increasing production and consumption, that is, the more widely distributed ownership would advance human welfare in so far as this is measurable in material things. It should therefore be one of the aims of industrial leaders, that is, of those who understand the aim of true leadership to increase human betterment, both to increase the quantity and to widen the distribution of wealth, using, of course, only such means as are just to all who are engaged in industry. The chief objection to the accumulation of too great amounts of capital in the hands of individuals is similar to that arising from entrusting to one man too great power of any kind. Even a Marxian socialist or a Russian bolshevist cannot deny the necessity of capital. Its accumulation in too great pools, giving great power and superabundance to a few individuals, is the greatest of the underlying causes of both movements.

Capital is stored labor, whether such labor was the effort of brain or brawn. But it is well not to take too material a view of capital. Much of it is stored in the disciplined mind and trained muscles, as well as in the effective organization, of those engaged in industry. It is unsafe to place too great reliance on such statistical figures as Mr. Ingalls compiles. The most important part of the capital of civilization is intangible. It cannot

be estimated and tabulated. Many of us have worked and saved most of our lives, but have accumulated very little tangible capital. The tangible capital of civilization is easily destroyed and easily replaced, because of the intangible capital, which is latent and potential, and which brings into existence tangible capital as needed or desired. This intangible capital, which is the summation of civilization itself, is of inestimable, but almost infinite, value.

As a contribution to economic discussion, pure and simple, the articles by Mr. Ingalls are well worthy of critical study; but, if viewed from the standpoint of the problem of the misunderstanding of labor and capital, as here and there throughout his essay would appear to be his purpose, his discussion may increase the already existing strain. I am optimistic enough to believe that a way out of the present industrial impasse can be found, in fact, that a start in the right direction has already been made.

The invention of the steam-engine marked the beginning, and the world war will probably come to be looked upon as marking the end, of the period or epoch of more purely mechanical development of industry. During this period the development and practical applications of mathematical, physical, chemical, and other material sciences were in the ascendant. The dazzling successes achieved concentrated almost every energy on the material aspects of wealth production and tended to divert attention from the only end that could make increase in material wealth worth while, the highest average of human welfare.

In the industrial epoch on which we are entering, the development and application of the sciences that deal with human beings and their organization into industrial and other social groups—economics, civics, ethics, sociology, psychology, industrial organization, history, and the like—will receive steadily increasing attention. Thus will the evils of an unbalanced industrial development come to be eliminated, a better balance be struck, and the highest benefits from the further development and application of the material sciences be achieved.

Because of his position in the development of industry, much of this new responsibility will rest on the engineer. But great discretion is needed on the part of those whose profession places them thus in the position of "a buffer between labor and capital". I am entirely in agreement with Mr. Sam Lewisohn that special training and experience are badly needed by engineering students as a preparation for this most important function in industry.

C. V. Corless.

Coniston, Ontario, November 11.

The Human Factor in Mine Management

The Editor:

Sir—I have read with much interest the letter by Mr. S. Lewisohn on this subject. He speaks of the difficulty of getting the mine manager to adopt modern methods in handling men. The question is, are modern methods effective? I was connected some years ago with a concern that started out to run its mine on the principle of the Y. M. C. A. We established a gymnasium, reading-room, held dances, etc., and made an honest effort to promote good feeling between the management and the men. The experiment (like hundreds of others) was a failure. A few of the more intelligent men appreciated our efforts. The majority looked upon it as a sign of weakness, and we finished up with a most disastrous strike, which nearly ruined the company.

There are no doubt cases where companies have been successful in building up an organization that had the interests of the company at heart, but these cases are rare, due largely to a rabid press and the work of radical labor leaders.

Mr. Lewisohn, I think, rather loses sight of the fact that human nature is complex, and very selfish. The director of a company expects a manager to handle his job and produce results, or his place is taken by another man. He has no union to protect him, and he is handicapped by handling men that can demand practically what they like (and get it) if their organization is strong enough. We have an example of this in the action of the railroad men of the United States and Canada. They say to the vast majority of brother-workers in these countries, "We know that although most of our railroads are bankrupt, and have to raise their rates to enable them to pay our present high wages, we are making life much harder for thousands of our fellow-workers, but we have decreed that our wages shall be such, and the public must pay the bill." And then they gather together and solemnly discuss The Brotherhood of Man.

We have another example of this among the coal-miners of Wales. Lloyd George, a Welshman himself, has for the last twenty years, showered benefits of every description on the miners of Wales. Minimum wages, old-age pensions, shorter hours, etc., are all the results of his untiring efforts to introduce the human factor into the mining industry. And the pity of it all is, he is the most hated man in Wales today.

Mr. Lewisohn says the day has passed when employers can ride roughshod over their employees. He is right, although for the last five years the shoe has been on the other foot, and the employees have ridden roughshod over the employer, and have not in many cases considered the human factor, as regards the employer. As regards the unions, I agree with Mr. Lewisohn that a union well run is a benefit to any industry, although I do not believe that trade-unionists will ever solve industrial unrest and discontent, because their principle is wrong. We have in Canada, roughly speaking, 400,000 union workers who dictate to the other seven million inhabitants of Canada the price they shall pay for the essentials of life. No one with any sense denies the right of any man by organizing to force the public to pay him the highest he can get for his commodity, which is labor, when the Government allows large corporations to form trusts and force the people to pay the highest prices for the common necessaries of life. Labor-unions also are trusts formed with a view to making all they can out of their fellow-men.

In my opinion if trade-unionism is going to be a success, it must come down to a common-sense basis, and teach its members to share the responsibilities of the management. Collective bargaining in the past has been a joke. As from a labor standpoint it only means, "I want a standard wage whether your business is paying or not." If, on the other hand, the labor leaders would set a wage based on the profits earned by a company, and accept a reduction when there was no profit, I can see a solution of the question.

We are, Sir, living in a sentimental age. You can hardly pick up a paper but what you read of the woes and sorrows of the man that works. As a matter of fact, there are no countries in the world in which workers are better off and more discontented than in Great Britain, the United States, and Canada. The manufacturers and employers of labor in Great Britain have worked the 'human factor' to such a pitch that before the War it was notorious that the output of a British workman was only one-half that of the mechanic in the United States or Canada.

As regards the failure to find mine managers that consider the human factor, I think Mr. Lewisohn is mistaken. I have been associated for many years with mine managers, and my experiences have been the reverse. Far too many are prone to take the easy road and go with the tide, and settle everything in favor of peace. This attitude is largely responsible for the present conditions of the mining industry. Prospecting is almost at a standstill. Many small companies (with, in some cases, poor stockholders) cannot afford to operate because costs are too high. This imposes a great hardship on the miner, as we have winter upon us and many will be out of work, and for this they cannot blame the small operator who is trying to develop his property. The miner usually calls your attention to the few large mines that are paying dividends. He seldom thinks, or will he discuss the hundreds of thousands of dollars that has been spent on unproductive prospects.

In handling men we must never lose sight of the fact that there must be mutual respect, which can never be bought through gifts.

We all know that Australia has gone through a system of modern innovations that was the admiration of the labor world. It has proved a failure. When any government takes a man by the hand and legislates his life for him, you kill ambition and thrift. Why should a man provide for the future when his life is cut and dried for him?

In talking about modern ideas, it is well to remember that although the world has seen some great advances in the arts and sciences, human nature has changed but little. We still have our ambitions, we love, and we hate, and in fact act very much as did our ancestors hundreds of years ago. Over all is thrown a thin veil of civilization. Before 1914 many of the leading statesmen of the Anglo-Saxon world said war was a thing of the past, but this theory did not materialize. The War came, with all its attendant horrors, and the thinking men of the world are forced to admit that human passions are much the same today as yesterday. I am convinced that what we need in the world today is more plain speaking, an honest press, and last of all, less greed and more courage on the part of directors of companies. Many a manager has put up a good fight against most unjust claims, and lost out, because his directors would not back him up. I am sure if every manager would pay the men he has in his employ the best wages he can, and if the company is prosperous, give a bonus in addition, it would stimulate ambition, and do more good than all the theories. The men are not children, and the great majority of them distrust the good intentions of the manager unless they are accompanied by a rise in wages.

I fear I have wandered away from my subject, but I am sure Mr. Lewisohn will admit that the managers of most of the large railroads and many of the industries of North America have not failed in their duty to their employees. They have recognized the human factor to a great extent, and the very industries (notably the railroad workers) in which they are engaged have the most discontented employees. Trade-unionists have not solved the problem of social unrest, and they never can until they educate their members up to a higher standard than (like Oliver Twist) to be eternally wanting more.

The fact is, employers of labor in America have been asleep at the switch. The labor-unions by good organization (and practical control of the press) are more or less masters of the situation, and the employers have done little or nothing to put their case before the public.

My conclusions are as follows: The human factor in dealing with labor has been tried and found wanting. The same can be said of the labor-unions. The solution is for all the employers to organize and meet organized labor on its own ground. It is only by doing this that we can hope to succeed.

The human factor must remain in business, but it must not be one-sided, or collective bargaining will count for naught.

F. J. Bourne.

Cobalt, Ontario, November 17.

Radium is the most valuable element in the world; one gramme of radium, which is about a thimbleful, costs $120,000, as opposed to $150 for an ounce of platinum. So powerful is it when mixed with other materials that even a minute particle is effective in making surfaces self-luminous for years. It is this quality which makes radium-luminous material commercially possible. The great value of radium is due to its scarcity, and to the great difficulty in isolating it after it has been found. Much of the radium of the world now comes from the carnotite ores of the United States. A great portion of this comes from the Undark radium mines in the Paradox valley of Colorado. The ore is found in narrow seams. It is sorted and packed in 100-lb. sacks and transported 60 miles to the nearest railroad station on the backs of burros and mules. Thence it is shipped in carload lots across the continent to an extraction plant in Orange, New Jersey. 250 tons of ore yields one gramme of radium.

Minerals Separation's Position Under the Patent Laws and the Anti-Trust Laws

By Gilbert H. Montague

*Minerals Separation owns, controls, and is interested in 68 United States patents. Of these, three only have been litigated: No. 835,120 (fraction of 1% oil), No. 962,678 (soluble frothing-agents), and No. 1,099,699 (phenol or cresol, cold, without acid). None of the remaining process patents, most of which cover merely some variant or alleged improvement of one of the above processes, and none of the apparatus patents, all of which together admittedly cover only a few of the many types of machines capable of use in flotation, have ever been litigated or invoked by Minerals Separation in any court against any alleged infringer.

Taking up these three patents, which alone have been litigated by Minerals Separation:

No. 835,120 (fraction of 1% oil) was patented in the United States on November 6, 1906, by three British subjects, Messrs. Sulman, Picard, and Ballot. Now 962,678 (soluble frothing-agents) was patented in the United States on June 26, 1910, by the same Mr. Sulman and two other British subjects, Messrs. Greenway and Higgins. No. 1,099,699 (phenol or cresol, cold, without acid) was patented in the United States on June 9, 1914, by the same Mr. Greenway. Considerable mystery has been thrown by Minerals Separation around the present ownership of these patents, but so far as can be ascertained (see testimony in Federal Trade Commission v. Minerals Separation, Ltd., et al., pp. 40-41, 324-325, 1015-1016) such ownership is somehow suspended between the parent company, Minerals Separation, Ltd., a British corporation, and its subsidiary, Minerals Separation North American Corporation, which the British parent company caused to be organized under the Maryland law in the midst of the Great War.

"To Promote the Progress of Science"

The Constitution of the United States (Art. I, Sec. 8, Clause 8) provides that Congress shall have power "to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries". That Congress was empowered simply "to promote the progress of science and useful arts", and was authorized to secure "for limited times" to "inventors the exclusive right" to their "discoveries" only in so far as this would "promote the progress of science and useful arts" and that the patent-owner's rights under the Constitution are thus conditioned by the Constitutional purpose "to promote the progress of science and useful arts" must always be remembered, and if my reference to this almost forgotten Constitutional provision, and to some often overlooked duties and obligations of patentees arising thereunder, seems sometimes too frequent, it is only because the arrogance of patentees in general, and Minerals Separation in particular, makes it constantly necessary to recall that, by the very words of the Constitution, Congress had no power to secure "for limited times" to "inventors the exclusive right" to their "discoveries" excepting in so far as such "securing" should "promote the progress of science and useful arts".

With this single Constitutional purpose in view, Congress has enacted that after filing in the Patent-Office a "written description" of his "invention or discovery", and "of the manner and process of making, constructing, compounding, and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound, and use the same", and "particularly point out and distinctly claim the part, improvement, or combination which he claims as his invention or discovery" (U. S. Revised Statutes, Sec. 4888, as amended, Act March 3, 1915, c. 94, Sec. 1), and after establishing, to the satisfaction of the Patent-Office, the fact of his "invention or discovery", the inventor shall then receive "a grant to the patentee, his heirs or assigns, for the term of seventeen years, of the exclusive right to make, use, and vend the invention or discovery throughout the United States, and the Territories thereof, referring to the specifications for the particulars thereof" (U. S. Revised Statutes, Sec. 4884). This grant, be it always remembered, is conditioned by the Constitutional purpose "to promote the progress of science and useful arts". Many times the courts have held that only in so far as the patentee has fulfilled this Constitutional purpose, and through his specifications and claims on file in the Patent-Office disclosed his "invention or discovery in such full, clear, concise, and exact terms as to enable any person skilled in the art . . . to make, construct, compound, and use the same" is the patentee entitled to a patent, and that for conduct tending to frustrate this Constitutional purpose, such as fraud, or intent to deceive, or excessive claims, the patentee must forfeit his patent.

Litigated Patents Soon Expire

Returning to the three patents that alone have been litigated by Minerals Separation:

*The author is of counsel for the American Mining Congress in the proceedings against the Minerals Separation company before the Federal Trade Commission. This paper was read at the meeting of the American Mining Congress at Denver on November 17, 1920.

No. 835,120 by assignment grants to the British parent company and to its controlled American subsidiary, Minerals Separation North American Corporation (or to the latter alone, according as may appear when the mystery of ownership is cleared up), "for the term of seventeen years", that is, until November 6, 1923, "the exclusive right to make, use, and vend . . . throughout the United States, and the Territories thereof" such "invention or discovery" as the patentees "particularly point out and distinctly claim" in respect of their so-called "fraction of 1%" oil process. Similarly, No. 962,678 grants to the same companies, until June 26, 1927, similar rights in respect of the so-called "soluble frothing-agents" process, and No. 1,099,699 grants to the same companies, until June 9, 1931, similar rights in respect of the so-called "phenol or cresol, cold, without acid" process. By their own terms, therefore, and by the express language of the statute, these companies must cease exercising these rights on November 6, 1923, June 26, 1927, and June 9, 1931, respectively; and by the precise words of the Constitution these rights are conditioned by the Constitutional purpose "to promote the progress of science and useful arts".

What are these rights, which, by the Constitution, the statute, and the patents themselves, must expire anyway in a few years, and by the language of the Constitution are conditioned "to promote the progress of science and useful arts", which now are so aggressively asserted against the entire mining industry by Minerals Separation?

Precise Limits of Patent No. 835,120

No. 835,120 has been litigated in the so-called Hyde case (Minerals Separation, Ltd., v Hyde, 207 Fed. 956, D. C. Montana, July 28, 1913; Hyde v. Minerals Separation, Ltd., 214 Fed. 100, C. C. A. Ninth C., May 4, 1914; Minerals Separation, Ltd., v. Hyde, 242 U. S. 261, U. S. Supreme Court, December 11, 1916) and in the so-called Miami case (Minerals Separation, Ltd., v. Miami Copper Co., 237 Fed. 609, D. C. Delaware, September 29, 1916; Miami Copper Co. v. Minerals Separation, 244 Fed. 752, C. C. A. Third C., May 24, 1917) and in the so-called Butte & Superior case (Minerals Separation, Ltd., v. Butte & Superior Mining Co., 245 Fed. 577, D. C. Montana, August 25, 1917; Butte & Superior Mining Co. v. Minerals Separation, 250 Fed. 241, C. C. A. Ninth C., May 13, 1918; Minerals Separation, Ltd., v. Butte & Superior Mining Co., 250 U. S. 336, U. S. Supreme Court, June 2, 1919).

In the Hyde case, after varying fortunes in the U. S. District Court for Montana and in the U. S. Circuit Court of Appeals for the Ninth Circuit, No. 835,120 (fraction of 1% oil) was sustained by the United States Supreme Court as regards the claims specifying *"the use of an amount of oil which is 'critical', and minute* as compared with the amount used in prior processes 'amounting to a fraction of one per cent. on the ore', *and in so impregnating with air the mass of ore and water used, by agitation 'by beating the air into the mass'*—as to cause to rise it the surface of the mass, or pulp, a froth, peculiarly coherent and persistent in character, which is composed of air bubbles with only a trace of oil in them, which carry in mechanical suspension a very high percentage of the metal and metalliferous particles of ore which were contained in the mass of crushed ore subjected to treatment" (Minerals Separation, Ltd., v. Hyde, 242 U. S., 261, 265), and was rejected as indefinite as regards the claims specifying a "small quantity of oil" (p. 271).

In the Miami case, the Circuit Court of Appeals for the Third Circuit started from the point settled by the Supreme Court decision in the Hyde case, that is, "that invention resides not alone in critical proportion of oil but also in air and agitation" (Miami Copper Co. v. United States, 244 Fed. 752, 758). "It is to be noted," said the Circuit Court of Appeals, by Judge Woolley writing for the Court, "that the Supreme Court did not construe the patent or determine its scope, for it had no occasion to do so" (p. 758). Accordingly, the Circuit Court of Appeals proceeded "to construe the patent in the light of that finding and determine whether the defendant's practices of aeration and agitation in connection with its admitted use of the critical proportion of oil, are within or beyond the scope of the patent" (p. 758). The Circuit Court of Appeals then considered the contention of Minerals Separation, Ltd., that "whenever the modifying agent of the patent [oil] is used, a person infringes who gets air into the pulp *in any fashion* and agitates the mixture *by any means* to a sufficient extent to cause the mineral particles to attach themselves to air bubbles and to rise therewith above the top of the mixture in a collection of bubbles and metal particles, to wit, froth" (p. 758). This obviously was an attempt by Minerals Separation to shift from the narrow ground that it previously had assumed, and that the Supreme Court in the Hyde case had adopted, and to place the patent upon another, and quite different, ground, which would be free from the inconvenient limitations implied in the position that Minerals Separation had assumed, and that the Supreme Court had sustained, in the Hyde case. The Circuit Court of Appeals rejected this contention and said: "The contention of the plaintiff at least omits the very definite limitation of the patent to the results obtained by the use of oil within the described proportions, and also the equally definite disclosure of an agitation in violence and duration greater than before employed" (p. 758). Construing No. 835,120, the Circuit Court of Appeals declared that the patentees "first told the art that a maximum metal recovery could be had from a minimum oil content", which "disclosure alone, interesting as it was, would have been valueless to the art, and would not have entitled the discoverers to a patent, until they told how and by what medium that phenomenon could be brought into practical use" and that accordingly the patentees "proceeded by further disclosures to tell the art that the way to produce the desired [illegible] is by . . . agitation 'greater than and *different from that which had been resorted to before'*, . . . *Agitation was thus made the practical element of*

their patented process, and by their patent disclosures they told the art that agitation was the secret by which the principle of their discovery could be unlocked and used" (p. 765). The Circuit Court of Appeals held that the first, second, and third flotation processes installed by the Miami company included agitation equivalent to that described in No. 835,120 and therefore infringed the patent, but refused to pass upon the so-called "fourth process" then being used by the Miami company. Discussing the Miami company's second process, the Circuit Court of Appeals said: "If the only agitation to which the pulp was subjected . . . was the agitation of the Callow cells, we would not say that that agitation . . . constituted infringement" (p. 768). One of the judges, it should be noted, dissented, and held that neither the second nor the third process of the Miami company included the agitation of the patent (pp. 775-792). That the Circuit Court of Appeals has no intention of hastily declaring the so-called "fourth process" used by the Miami company, or the different variants of this process, used since 1917, to be infringements of No. 835,120 appears from the Court's refusal, in June 1920, to hold at this time that the Miami company is violating the Court's decree in using any of these variants or substitutes.

In the Butte & Superior case, after varying rulings by the U. S. District Court for Montana and the U. S. Circuit Court of Appeals for the Ninth Circuit, the U. S. Supreme Court on June 2, 1919, held that the "essence of the discovery" covered by No. 835,120 was the *reduction* of the total amount of "oily substance" used in the process to any "fraction of one per cent on the ore", plus "*vigorous agitation*", resulting in "flotation mainly from the inclusion of air bubbles introduced into the mass by agitation. (Minerals Separation v. Butte & Superior Mining Co., 250 U. S. 336, 346-347, see also 341-2, 344-7).

Minerals Separation, Ltd., the British parent company, and its controlled American subsidiary, Minerals Separation North American Corporation, began suit upon No. 835,120 against the Nevada Consolidated Copper Co. in September 1919, and against the Magma Copper Co. in January 1920, both in the U. S. District Court for Maine. Both mining companies have filed elaborate answers, which foreshadow their defence that the processes they are using are wholly different processes, lying outside No. 835,120, because they depend upon air bubbles introduced or generated not by "agitation" but solely by Callow or pneumatic cells, and do not depend upon, nor in any way involve, the "vigorous agitation" which the Supreme Court in the Hyde case and in the Butte & Superior case, and the Circuit Court of Appeals for the Third Circuit in the Miami case, held to be essentially characteristic of No. 835,120 (fraction of 1% oil).

Precise Limits of Patent No. 962,678

No. 962,678 (soluble frothing-agents) has been litigated only in the so-called Miami case (Minerals Separation v. Miami Copper Co., 237 Fed. 609, D. C. Delaware, September 29, 1916; Miami Copper Co. v. United States, 244 Fed. 752, C. C. A. Third C., May 24, 1917), where the Circuit Court of Appeals for the Third Circuit sustained the patent, as to four of its claims, in which the frothing-agent is "*a small percentage*" of one or more specified soluble "organic substances" (instead of oil as in No. 835,120) and the "mixture is thoroughly agitated" or "vigorously agitated" by "beating air into it" (Miami Copper Co. v. Minerals Separation, 244 Fed. 752, 771-774). "Here [in No. 962,678] as well as there [No. 835,120]", said the Circuit Court of Appeals, by Judge Woolley writing for the Court, "the decision turns upon the kind and degree of *agitation* employed by the defendants . . . what has been said about infringing agitation in the oil process [No. 835,120] must also apply to the same agitation when considered in reference to the second process [No. 962,678]" (p. 774).

Minerals Separation and its American subsidiary began suit upon No. 962,678 (soluble frothing-agents) against the Nevada Consolidated Copper Co. in February 1920, and against the Magma Copper Co. in January 1920, both in the U. S. District Court for Maine. Both mining companies have filed elaborate answers which foreshadow their defence that the processes which they are using are wholly different processes which lie outside No. 962,678 because they depend upon air bubbles introduced or generated not by "agitation" but solely by Callow or pneumatic cells, and do not depend upon, or in any way involve the "vigorous agitation" which the Circuit Court of Appeals for the Third Circuit in the Miami case held to be essentially characteristic of No. 962,678.

Precise Limits of Patent No. 1,099,699

No. 1,099,699 (phenol or cresol, cold, without acid) has been litigated only in the so-called Miami case (Minerals Separation, Ltd., v. Miami Copper Co., 237 Fed. 609, D. C. Delaware, September 29, 1916; Miami Copper Co. v. Minerals Separation, Ltd., 244 Fed. 752, C. C. A. Third C., May 24, 1917), where the District Court held the patent invalid, but the Circuit Court of Appeals for the Third Circuit sustained it. The process covered by this patent consists "in mixing a powdered ore . . . with neutral water containing in solution *a minute quantity*" of hydroxy compounds and "*agitating* the mixture in the cold to form a froth and separating the froth" (Miami Copper Co. v. Minerals Separation, 244 Fed. 752, 774). The Circuit Court of Appeals held that by dispensing with heat and acid by using "*a minute quantity*" of hydroxy compounds (that is, phenol, cresol, etc.) the patentee disclosed an original and novel plant which has broadened and made more simple the *agitation* process of air flotation" (p. 775). Neither Minerals Separation, Ltd., the British parent company, nor any of its subsidiaries, has ever sued anyone else upon this patent.

Occupied Zone of Minerals Separation

Summarizing the rights that Minerals Separation, Ltd., the British parent company, and its controlled American subsidiary, Minerals Separation North Ameri-

can Corporation, have under the only patents that it has litigated.

Under No. 835,120, conditioned always upon the Constitutional purpose "to promote the progress of science and useful arts," the patentees have the "exclusive right", expiring in any event on November 6, 1923, merely to the process of *reducing* the total amount of "oily substances" to any "fraction of one per cent on the ore" and adding "*vigorous agitation*", "greater than and different from that which had been resorted to before"—"by beating the air into the mass"—so as to produce "flotation mainly from the inclusion of air bubbles introduced into the mass by agitation", which right the Court has expressly held does not cover *any process in which the total amount of "oily substances" exceeds "one per cent on the ore", nor any process in which air gets "into the pulp in any fashion", or "by any means" (such as "the agitation of the Callow cells"), different from the "vigorous agitation" mentioned in the patent.*

Under No. 962,678, conditioned always upon the Constitutional purpose "to promote the progress of science and useful arts", the patentees have the "exclusive right", expiring in any event on June 26, 1927, merely to the process of *using* "a small percentage" of one or more specified soluble "organic substances" and *agitating* the mixture "thoroughly", or "vigorously", "beating the air into it", which right, by well-settled law, *does not cover any process in which the total amount of such "organic substances" exceeds the "small percentage" referred to in No. 962,678 (soluble frothing-agents), nor any process in which air gets "into the pulp in any fashion", or "by any means", different from agitating it "thoroughly", or "vigorously", or "beating the air into it".*

Under No. 1,099,699, conditioned always upon the Constitutional purpose "to promote the progress of science and useful arts", the patentees have the "exclusive right", expiring in any event on June 9, 1931, merely to the process of *using* "a minute quantity of hydroxy compounds" without acid and "*agitating* the mixture in the cold to form a froth", which right, by well-settled law, *does not cover any process in which the total amount of hydroxy compound exceeds the "small percentage" referred to in No. 1,099,699 (phenol or cresol, cold, without acid), nor any process in which air gets "into the pulp in any fashion", or "by any means", different from the agitation described in the patent.*

These precise limits of Minerals Separation's three litigated patents define the entire zone which, so far as the courts have decided, Minerals Separation today has any legal right to occupy in the field of flotation.

Occupied Zone Soon to be Vacated

By the express conditions of this occupation, prescribed by the Constitution, the statute, and the patents themselves, Minerals Separation on November 6, 1923, must evacuate the first sector of this occupied zone, which it now holds upder No. 835,120; and on June 26, 1927, must evacuate the second sector, which it now holds under No. 962,678; and on June 9, 1931, must evacuate the third and last sector which it now holds under No. 1,099,699.

The plain emphatic intention of the Constitution, the statute, and the patents themselves is that on November 9, 1931, Minerals Separation's evacuation from this occupied zone shall be complete, and that Minerals Separation's present servitude over this occupied zone shall then cease, and that this entire occupied zone shall then be wholly free to everyone.

The "exclusive right" for which the patentees bargained when they "disclosed" their processes and obtained their patents was, as they then well knew, by the Constitution, the statute, and the patents themselves, absolutely and strictly limited to this. After the 17-year period for each patent has expired, freedom to everyone to use these processes, without paying royalty or incurring any obligation of any kind to Minerals Separation was, as the patentees then well knew, one of the absolute essentials of this bargain, because if this essential should fail, then the sole Constitutional justification for this "exclusive right", namely "to promote the progress of science and useful arts", would also fail, and the entire Constitutional purpose would be utterly frustrated. I say, advisedly, "one of the absolute essentials of this bargain" because there is another essential equally necessary to the Constitutional purpose "to promote the progress of science and useful arts". Inventors, engineers, manufacturers, and others, independent of, and competitive with, the patentees, must be permitted and encouraged, at every moment throughout these 17-year patent-periods, to utilize every suggestion which the patents themselves afford to make every independent and competing "invention or discovery" possible in the area outside the occupied zone of the patents. Suppression, intimidation, molestation, or harassment by the patentees of such investigations of such independent and competing inventors, engineers, manufacturers, and others thwarts the Constitutional purpose "to promote the progress of science and the useful arts", and destroys the sole Constitutional justification for the patentees' "exclusive right". To abstain from these practices is just as much the patentees' duty, under the Constitution and the patents themselves, as is their duty to cease to exercise their "exclusive right" at the expiration of the 17-year patent-periods.

How defiantly Minerals Separation, throughout its career in the United States, has evaded these two duties, appears in the standard license agreements that Minerals Separation has executed with dozens of American mine-operators who have never contested Minerals Separation's patents, who at great cost to themselves have quarterly paid to Minerals Separation the exorbitant royalties exacted under these agreements, and who are now discovering from the Federal Trade Commission's evidence that the royalites which Minerals Separation is exacting from them in some cases several times exceed the royalties paid by their more favored rivals and com-

petitors, and that having executed these agreements they must continue forever to pay these royalties, always handicapped by the lower royalties enjoyed by their more favored rivals and competitors, and after November 6, 1923, June 26, 1927, and June 9, 1931, still further handicapped by competition from rivals and competitors, who, not having executed any agreements with Minerals Separation, will after these dates be free to use the respective processes covered by Minerals Separation's three litigated patents without paying any royalty or incurring any obligation of any kind to Minerals Separation.

Stretching Seventeen Years Into Eternity

Minerals Separation's first duty, under the Constitution, the statute, and its patents themselves, is to evacuate, sector by sector, on November 6, 1923, June 26, 1927, and June 9, 1931, the occupied zone of Minerals Separation's three litigated patents.

To evade this duty, Minerals Separation annexes to its standard license agreement a "schedule" setting forth these three litigated patents, and also all its other United States patents, 65 in number, none of which have been litigated, and most of which cover merely some variant or alleged improvement of processes or apparatus described in earlier patents, and all of which Minerals Separation has succeeded in obtaining from the Patent-Office at the rate of from one to ten new patents each year. The American mine-operator, as a rule, desires to use only one, or at most two or three, of the processes and apparatus described in these 68 Minerals Separation patents. Minerals Separation invariably refuses, however, to give him this permission unless he executes a license agreement, in the standard form of which Minerals Separation recites that "the licensors [Minerals Separation] hereby grant unto the licensees [the American mine-operator] full license power and authority to make, use and exercise any or all of the inventions described and claimed in the letters patent within this license" at such mine as the license agreement specifies, "during the terms of the letters patent within this license or any of them and any extension thereof". Elsewhere in the license agreement, Minerals Separation recites that the "letters patent within this license" mean "all or any of the inventions, processes or apparatus described and claimed in the said letters patent *and any letters patent for the concentration of ores that are or may become the property of the licensors* [Minerals Separation]". This effectively brings within the phrase "letters patent within this license" all patents which Minerals Separation may thereafter succeed in getting patented, which, judging from past experience, will aggregate from one to ten new patents each year until the end of time. The life of the license agreement, therefore, which runs until seventeen years after the date of the latest patent among the "letters patent within this license" will be, until the end of time, extended each year by the addition of new patents, and the license agreement will thus become perpetual, unless Minerals Separation's plans are upset by the Federal Trade Commission.

Royalties, Discriminatory and Eternal

Several Minerals Separation licensees, as I have stated, pay royalties which are only a fraction of those charged by Minerals Separation to other licensees similarly situated, whom Minerals Separation has required to execute standard license agreements. Such discrimination handicaps each such standard licensee in competing with his more favored rivals, and its correction is one of the objectives of the Federal Trade Commission's proceeding against Minerals Separation.

The eternal duration of Minerals Separation's licensee agreements presents a situation which insistently calls for relief from the Federal Trade Commission. How it operates upon Minerals Separation's licensees may be illustrated by their plight upon the expiration of the patents covering the only Minerals Separation processes which they may happen to be using.

Assume that a Minerals Separation licensee is using only No. 835,120. On November 6, 1923, this patent expires. The plain emphatic intention of the Constitution, the statute, and the patent itself is that on that date Minerals Separation shall completely forfeit its present "exclusive right" to the process covered by this patent, that Minerals Separation's present servitude on the art through its ownership of this patent shall then cease, and that this process shall then be wholly free to everyone. Mindful of this, the licensee, let us assume, who several years before, in order to obtain permission to use merely this "fraction of 1%" oil process, executed with Minerals Separation a standard license agreement, and who has never contested with Minerals Separation this or any other patent, and who at great cost to himself, has paid quarterly to Minerals Separation the exorbitant royalty exacted by this license agreement, and who has never used any process or apparatus belonging to Minerals Separation excepting only the process covered by this patent now expired, takes out this license agreement and reads it over in the expectation of finding that all his obligations to Minerals Separation have now been fully discharged, and that now he may freely use this process without paying any royalty or incurring any obligations to Minerals Separation or anyone else. His license agreement, and thus his obligation to pay royalties, he now discovers, do not end when the patent expires, but continue as long as he uses the process, continue even while his rivals who executed no agreements with Minerals Separation are absolutely free to use the process without paying any royalty to Minerals Separation, continue even while his competitors who defied Minerals Separation and contested its patent are using the process without incurring any obligation of any kind to Minerals Separation or anyone else, and will so continue until the end of time, with the requirement that he account quarterly and settle promptly with Minerals Separation in the same exorbitant figures, so long as he continues to use the process of this now expired patent.

Other Conditions of Servitude

Article 3 of Minerals Separation's standard license

agreements provides that throughout the eternal life of these agreements, all licensees must disclose and turn over to Minerals Separation the ownership of "every invention or discovery made or used by them which may be an improvement, modification, or addition to any of the inventions specified in the letters patent within this license or may be useful in carrying out any of the processes" above-mentioned, and that all licensees must, so far as practicable, "bind their employees" to turn over to Minerals Separation all such inventions made by such employees, and that no licensee may use "any improvement, modification, or addition to any of the inventions specified in the letters patent within this license" except upon request to, and consent by, Minerals Separation. Articles 6 and 9 provide that throughout the eternal life of these license agreements the licensee "shall not in any way directly or indirectly support or assist third or hostile parties" such, for instance, as the Federal Trade Commission, "in any litigation against licensors", and "shall not without the written consent of the licensors communicate any detail connected with the working of any of said inventions, modifications, additions, or improvements to any third party".

If, as Minerals Separation claims (erroneously, as I believe), these license agreements ought to be executed by every mine-operator practising the art of flotation, it would follow that every mine-operator who by any possibility could interest himself in inventing any improvement in the art, now or at any time in the future, would be perpetually subject to the bondage of Minerals Separation.

Nothing approaching the duration, extent, and burdensomeness of the servitude imposed by Minerals Separation has ever been presented in any reported decision in the State or Federal courts. This intolerable and perpetual servitude Minerals Separation seeks to impose upon the entire mining industry of the United States, and upon all present and future inventive genius which in this or any future generation can by any possibility advance the art of flotation. Compared with Minerals Separation, every other trust that the Government has dissolved under the anti-trust laws pales into insignificance, for Minerals Separation seeks to bring within its combination and monopoly not only all processes and apparatus that its own employees may develop, but also all processes and apparatus that any mine-operator anywhere, who now or at any future time uses flotation, may now or at any future time by any possibility invent or discover. To curb this extravagance of monopoly, and to place limits upon these eternal license agreements, are among the objectives of the Federal Trade Commission's proceeding against Minerals Separation.

Obstructing the Progress of Science

Minerals Separation's second duty, under the Constitution, the statute, and its patents themselves by which Minerals Separation's "exclusive right" under these patents is conditioned, is not to thwart the Constitutional purpose "to promote the progress of science and useful arts". This Constitutional purpose requires that independent and competing inventors, engineers, manufacturers, and others should be permitted and encouraged to utilize every suggestion that Minerals Separation's patents afford to develop and exploit every independent and competing "invention or discovery" possible in the area outside the occupied zone of Minerals Separation's patents, and that Minerals Separation should abstain from suppressing, intimidating, molesting, or harassing independent and competing inventors, engineers, manufacturers, and others engaged in such development and exploitation.

In defiance of this duty, the Federal Trade Commission charges, Minerals Separation has tried to prevent independent and competing inventors, engineers, manufacturers, and others from exploiting independent and competing processes and apparatus, has tried to prevent American mine-operators from using such independent and competing processes and apparatus, has falsely and maliciously disparaged such independent and competing processes and apparatus, has falsely and maliciously claimed patent-rights in excess of those actually possessed by Minerals Separation, has maliciously threatened to prosecute American mine-operators who were using such independent and competing processes and apparatus, has seduced, corrupted, and bribed employees of American mine-operators to give Minerals Separation confidential information regarding their employers' operations, and in various ways has tended to suppress, intimidate, molest, and harass the development and exploitation of independent and competing "inventions or discoveries" in the area outside the occupied zone of Minerals Separation's patents, and has thus tended to frustrate the Constitutional purpose "to promote the progress of science and useful arts" by which Minerals Separation's "exclusive right" under its patents is wholly conditioned. These practices attributed to Minerals Separation, which properly belong under another topic announced for this Convention, the Federal Trade Commission proposes to stop.

All these practices, according to the Commission's complaint, Minerals Separation has been committing for many years, with such success that by means of them Minerals Separation has stifled and suppressed the development and exploitation of independent and competing processes and apparatus, and has prevented actual and potential competition from independent and competing inventors, engineers, manufacturers, and others, and has thus obtained that position of power and dominance which now enables Minerals Separation to charge exorbitant and discriminatory royalties

What the Commission can Accomplish

The Commission's purpose is not to dislodge Minerals Separation from the occupied zone which Minerals Separation succeeded in capturing in its first legal onset upon the American mining industry. That task is being attempted only by the American mine-operators who are now defending themselves against Minerals Separation

suits above described. The Commission's object is to ensure that Minerals Separation shall fulfill its plain emphatic duty under the Constitution, the statute, and its patents themselves, to evacuate, sector by sector, on November 6, 1923, June 26, 1927, and June 9, 1931, the occupied zone of Minerals Separation's three litigated patents, and meanwhile not to suppress, intimidate, molest, or harass independent and competing inventors, engineers, manufacturers, and others now working outside this occupied zone, and that Minerals Separation shall not utilize its ingenious entrenchments, its skilfully planned attacks, its enormous exactions of tribute from the occupied zone under its servitude, its awe-inspiring preparations for extorting colossal indemnities from the outside realm of flotation, and its campaign of commercial *schrecklichkeit* generally, for the purpose of evading this plain emphatic duty.

The Federal Trade Commission, in most of the proceedings which it has heretofore brought, has found, like the Supreme Court in the Standard Oil case (Standard Oil Co. v. United States 221, U. S. 1, 77) "that ordinarily where it was found that acts had been done in violation of the statute adequate measure of relief would result from restraining the doing of such acts in the future". But in the present proceeding, the Federal Trade Commission will find as the Supreme Court of the United States found in the Standard Oil case, that "in a case like this, where the condition which has been brought about in violation of the statute, in and of itself, is not only a continued attempt to monopolize, but also a monopolization, the duty to enforce the statute requires the application of broader and more controlling remedies" (p. 77).

The Federal Trade Commission's authority for devising and applying these remedies is ample under the Federal Trade Commission Act and the Clayton Anti-Trust Act. Adequate remedy in the present situation will never be obtained until the Commission, by explicit directions in respect of the amount of royalties to be charged by Minerals Separation ensures that such royalties are not in excess of what they would have been had not actual and potential competition from rival processes and rival apparatus, and from rival inventors, engineers, manufacturers, and others, been stifled and suppressed by Minerals Separation over a period of years. Merely to enjoin at this late day, the continued practice by Minerals Separation of the particular methods of unfair competition set forth in the Commission's complaint will not immediately revive the actual and potential competition which Minerals Separation has for years been stifling and suppressing. Not for several years, perhaps not for many years, can this competition be revived, nor the mining industry be made safe for rival processes and rival apparatus and rival inventors, engineers, manufacturers, and others to compete with Minerals Separation. Until that time arrives, therefore, the Federal Trade Commission, "re-creating, out of the elements now composing it, a new condition which shall be honestly in harmony with and not repugnant to the law" (United States v. American Tobacco Co., 221 U. S. 106, 187), should make explicit directions as to the amount of royalties to be charged, to the end that the exorbitant and discriminatory royalties, which are the purpose and crowning accomplishment of years of unfair methods of competition on the part of Minerals Separation, may not be perpetuated after the mere practice of such methods has been discontinued.

Following the reading of this paper at the American Mining Congress, Alfred A. Cook, legal counsel and one of the directors of Minerals Separation North American Corporation, speaking as he stated "subject to correction" by the Corporation's officials in New York, questioned my statement above that after November 6, 1923, a Minerals Separation standard licensee "who has never used any process or apparatus belonging to Minerals Separation, excepting only the process" covered by No. 835,120, then expired, would still be obligated to continue to pay royalties to Minerals Separation.

To clear up this difference regarding the plain meaning of Article 1 of Minerals Separation's standard license agreement, which unequivocally provides, without any time limitation whatsoever (in this respect unlike Minerals Separation's agreements with certain favored licensees which by their terms expressly expire November 6, 1923), that "the licensees shall pay royalties to the licensors for the *use* of all processes and appliances embodying all or any of the inventions described and claimed in the letters patent within this license" at the rate specified by the agreement, Mr. Cook, at my suggestion, telegraphed to New York, and on the following day received from the president of Minerals Separation North American Corporation a reply to the effect that such a licensee would not be obligated to continue to pay royalties to Minerals Separation.

Since this same official, in a letter read by Mr. Cook on the previous day, had stated that the obligation to pay royalties continued so long as the process was *used,* and since the vice-president of Minerals Separation North American Corporation had similarly testified in the Federal Trade Commission proceeding (record p. 580), I promptly expressed to Mr. Cook my grateful appreciation of this apparently magnificient concession by Minerals Separation.

Further discussion of the same point, however, promptly developed the fact that while so modifying Article 1, Minerals Separation was by no means ready to modify Article 5, which provides that "the licensees shall not directly or indirectly during the continuance of this license nor at any time after the termination thereof dispute or object to the validity of the letters patent within this license or the novelty or utility of the inventions specified therein"; and that therefore any licensee using the process now covered by No. 835,120, then expired, would be obliged to accept Minerals Separation's opinion as to whether such process was covered by any of the scores of other "letters patent within this license", and would be prevented by Article 5 above quoted from ever "disputing or objecting" to Minerals Separation's

opinion on this subject. The record in the Federal Trade Commission proceeding abounds in expressions of Minerals Separation's opinion to the effect that every conceivable process of flotation is covered by one or another of its scores of patents, so that so long as Article 5 stands, any licensee who after November 6, 1923, ventures to discontinue paying to Minerals Separation full quarterly royalties upon the basis specified in his license agreement may be sued by Minerals Separation for alleged infringement of any of its scores of other patents, and by the provisions of Article 5 will be estopped from ever disputing or objecting to the validity of such patent or the novelty or utility of the alleged invention specified therein.

This apparently magnificent concession by Minerals Separation, with which Mr. Cook, by his gallant and chivalrous manner, succeeded in raising high hopes among his listeners at the Convention, thus proved to be entirely illusory.

That every other restraint above described, imposed by Minerals Separation's standard license agreement, was in effect eternal because of the ingenious provisions above described for extending the life of the agreement was not disputed by Mr. Cook.

Platinum

By S. Skowronski

*The most valuable of the industrial metals in the world today are those comprising what is known as the platinum group. These metals, all of which are allied with platinum in their chemical and physical properties, are associated with platinum in native ores or deposits found principally in Russia and in the Republic of Colombia. On September 18 the quotations for these metals per troy ounce, were as follows: platinum, $115; palladium, $105; iridium, $375; ruthenium, $210; and osmium, $62. In the electrolytic refining of copper and nickel, platinum and palladium have been found in large enough quantities to warrant the recovery of these metals. Platinum was first discovered in Colombia, in about 1735, and on account of its white silvery appearance, was called 'platina', the diminutive form of the Spanish 'plata' meaning 'silver'. Owing to the high specific gravity of platinum, it being a little higher than gold, it was first used in the adulteration of gold, and on this account, the Spanish government at one time ordered all of the metal on hand thrown into the sea, and would not allow the exportation of the metal from South America. In 1819 the great deposits of the platinum metals in the Ural mountains of Russia were discovered, and since that time Russia has been the great exporter of platinum metals.

Platinum was formerly extensively used for the evaporation of sulphuric acid in sulphuric acid works, large pans of platinum being used for that purpose. Finely divided platinum possesses the remarkable property of promoting or hastening chemical changes without undergoing any decomposition, acting, as what is known to chemists, as a catalizer.

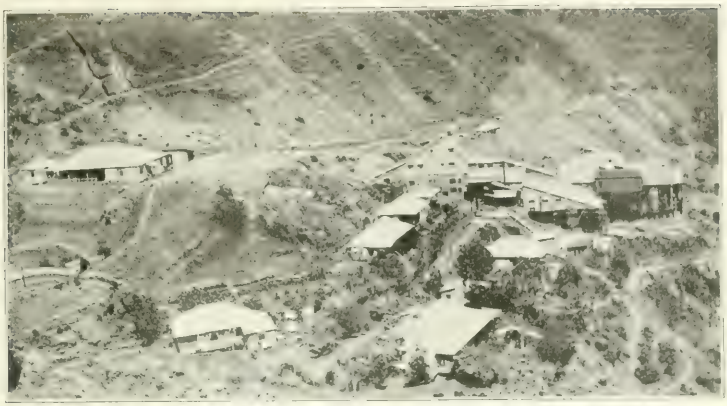
Owing to its high melting point and resistance to corrosion and fumes, platinum was formerly used in the construction of small electric-resistance furnaces and heating elements for laboratory work; also for the manufacture of contact points, in various types of ignition systems, magnetos, and spark coils, but owing to the continued increase in the price of the metal, substitutes are now being used. The most important use for platinum is in dental work and formerly fully one-third of the total production of the metal was used for that purpose. Platinum being non-corrosive and not affected by the acids of the mouth, is an ideal metal for the construction of pins, pivots, and anchors of artificial teeth and other dental work.

Platinum is indispensable for scientific purposes, and the increasing use of the metals in jewelry has, at times, been sharply criticized by scientific men, a quotation from one of the scientific journals being as follows: "From the scientific point of view, much regret is felt that platinum has found employment in the jewelry trade. Silver or gold is much better adapted to the production of attractive ornaments and is more beautiful than the grayish-white of platinum, while, of course, neither metal has the high fusing point and the resistance to acids which makes platinum indispensable in science and the industrial arts. The scientific and technical world needs all the platinum that can be obtained."

The jewelry trade in turn attempts to justify the use of platinum in jewelry in the following article copied from a trade paper: "Platinum is the metal par excellence for fine and delicate jewelry. First, because its brilliant white color enables the jeweler to obtain beautiful effects in the setting of diamonds, which cannot be obtained with gold, owing to its yellow color. Secondly, on account of its malleability, ductility, rigidity, and tenacity, the most delicate and intricate designs are possible with a surprisingly small amount of metal. Lastly, because jewelry made of platinum will retain stones in its settings without the heavy beading required in gold settings and will not tarnish or oxidize from exposure to air, fumes, or acids, or when worn on the body. This combination of qualities does not exist in any other known precious metal and has made possible most of the great advance in the jewelry art of recent years."

In the electrolytic refining of copper, the platinum and palladium present in the original crude or blister copper, concentrate to the very end of the process and are recovered from the electrolyte of the Wohlwill process used in the electrolysis of gold. It is only within the past ten years that the copper refineries have been recovering the platinum and palladium present in the copper. Formerly it accumulated and was shipped in the gold bars and was lost to the plants. While the total amount of platinum metals recovered in the refineries is small, it is practically the only source of these important metals which this country has, as the native ores or platinum sands furnish only 700 oz. of crude metals yearly.

*From 'The Ingot'.



THE MINE, THE MILL, AND THE OFFICES

Milling Practice at the Benguet Consolidated Mine—II

Details of Practice

By C. M. Eye and M. F. Dodd

Breaking. As most of the ore when it comes from the mine is sufficiently fine to pass the grizzley-bars, it is only necessary to operate the crusher at intervals, the total running time amounting to but a few hours daily. It is now driven from the 10-hp. motor, at a speed of 280 r.p.m. through the medium of a short-centre drive, which is more satisfactory than the former long drive.

Dry Elevating and Washing. The feeder, elevator, and trommel, operated as a unit from a line-shaft driven by a 5-hp. motor, work efficiently except when the ore comes from the mine wet and sticky. Then trouble is experienced through its hanging up over the feeder, packing in the buckets of the elevator, and (when much clay is present) balling up in the washer and passing in chunks to the bin. Ordinarily, however, the service is satisfactory. The 12-in. rubber belt of the elevator is protected by the backs of the buckets, which form a continuous line. The buckets, 10 in. wide, fabricated of No. 12 gauge steel, show little wear after long usage. The principal wear occurs on the screen covering of the trommel, after the addition of solution, and especially toward the lower end, after the removal of the most of the fine. Steel-wire screens with rectangular openings were first tried, but a set lasted only from four to five weeks. Punched-steel screens with elliptical openings, $\frac{1}{4}$ by $\frac{3}{4}$ in., were substituted with better results. The longer dimension of the holes is at right angles to the axis of the trommel.

Stamping. As previously noted, the ten stamps are driven by a back-geared motor. The drive, through the medium of a 14-in. belt, is nearly horizontal, with a tightener pulley on the upper side. A spare 25-hp. motor of the same kind is set directly back of the one ordinarily used, so that, in case of necessity, the change to it can be made quickly. This ensures practically continuous stamp-operation, which was more important when all the material had to pass the stamps than now, when they have to crush the coarse material only. The drop is now 7.5 in., 106 times per minute. This is a greater drop than was formerly necessary. Then the indicated horsepower at the motor was about 17.5; it is somewhat greater now. Excessive splash is prevented by hanging a light steel plate from the top of each screen-frame. Goldfield guides with removable split shells are used satisfactorily.

Classification. The drag-classifier, receiving the stamped product, consists of a five-ply balata belt 8 in. wide with flights of 2-in. angle-iron bolted to it at 12-in. intervals, working over a head pulley of 16 in. diameter and a tail pulley of 26 in., in a wooden tank, 26 in. wide, 24 in. deep at the lower end, and 14 ft. long. It is driven at the head end, by belt and spur-gear, giving a belt-travel of 28 ft. per minute. As none of the bearings are submerged, no stuffing-boxes are necessary. Every fourth flight is 22 in. long, the rest are 18 in., giving a head product of less moisture than if the flights were of equal length. This machine, built on the ground, has given good service over a period of years, one belt having lasted three years. It may be termed a roughing-classifier, for removing the bulk of the coarse product for direct delivery to the tube-mill.

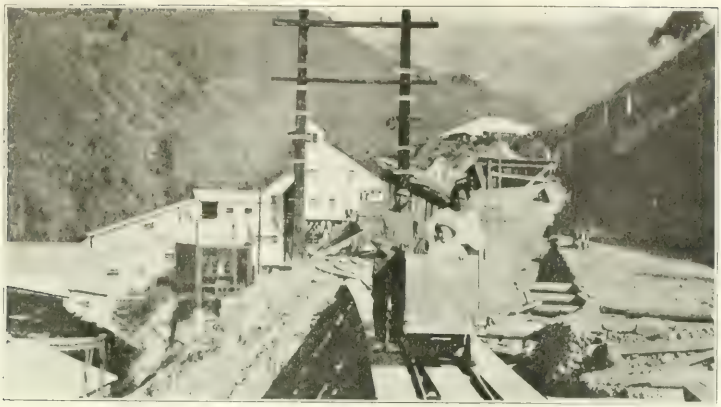
The primary Dorr classifier performs a somewhat similar function on the portion of the pulp by-passing the stamps, by removing a coarse product for tube-milling, and passing the finer to the two secondary classifiers, working in closed circuit with the grinding-mills, and furnishing the final finished product for treatment. This product, on which frequent screen-tests are made, usually has about 5% coarser than 100, and only 10% coarser than 200-mesh. Assays on the pulp at this point show that about 60% of the precious metals is dissolved. The degree of dilution is usually about six of solution to one of solid.

Fine Grinding. This is done in two Dewco tube-mills identical in every respect, except as to length; the newer one being two feet shorter than the other. It was thought that the new mill, working on the softer material coming directly from the washing system, would finish it as effectively as the longer mill, working on the stamped material. This does not appear to be the case, as there is a greater proportion of oversize in its discharge. There is a direct saving in power, of course, as this mill operates with a 40-hp. motor instead of a 50, but it is the opinion that 10 ft. is the proper length for a 6-ft. mill on this ore. The new mill is driven by a 14-in. belt without a friction-clutch, from a motor of high starting-torque. This has not proved so satisfactory in practice as the drive on the older mill from an ordinary motor by a friction-clutch, as this enables full speed to be attained on the motor before the mill is engaged. Both drives are nearly horizontal. A so-called boltless type of shell-liner is used, requiring no bolting through the shell of the mill. Each circle, 6 in. long, is complete in itself, and consists of six segments, four with plain radial ends, and two with plain ends at one extremity and a lug arrangement at the other, whereby, after a circle is in place, it can be expanded tightly against the inside of the shell, by means of a 1-in. steel bolt. Steel shims of various thickness are placed in the plain joints to give better bearings and to adjust the circle. On the circles that include the man-hole frame, which is 18 in. long, one of the plain segments is shorter than the others by the width of the frame. When the liners are in place, there is presented a series of pockets on the inner surface of the mill, which fill quickly with pebbles and thus form a superior wearing-surface. These pockets just about take a No. 5 flint pebble nicely. The total depth of the liners, with the back of one inch, is six inches, so the effective diameter of the mill when lined is five feet. The total weight of shell-liners sufficient to line both mills is ten tons. A set of ordinary hard white-iron lasts from five to seven months, the weight of the discarded liners being about 55% of that at the beginning. The greater part of the wear is in the pebble-filling, and when the liners wear down to the point where the filling does not hold well, it proceeds more rapidly. When it has reached the bolts and lugs and these are worn off, the lining is held only by the 'set' of the pebbles and fine ore that has cemented every crevice. Usually this is sufficient to hold the circles in place until the back is nearly reached, when the liners may go out entirely. If one particular ring happens to wear faster than the rest, it is possible to replace worn segments with others recovered from former linings, but the point is soon reached where the whole set must be replaced. This is done quickly, the entire change usually requiring not to exceed ten hours, the removal of the old segments taking more time than the placing of the new ones. An effort is being made to increase the life of the liners without too great increase of cost by using liners of higher-grade material than white-iron. No figures are as yet available on this, however.

The heads of the mills are lined with two circles of segments constituting 'inner' and 'outer' head-liners, any segment of either circle being removable independent of the others or of the shell-liners. As a rule, however, an entire circle is replaced at one time. These are held by bolts through the heads in the usual way. Only hard white-iron has been used for this as yet. The first mill was equipped with a scoop-feeder with a 5-ft. radial sweep, rendered necessary by reason of the classifier working alongside in closed circuit, but since the classifiers have been raised to the floor above, enclosed spiral feeders are used to great advantage. The long-sweep scoop-feeder never was satisfactory. The speed of the mills is maintained at about 27 r.p.m. for the best results. Pebbles are fed as a rule through the head end, since the spiral feeders are used; formerly the bulk of the pebbles was fed through the discharge end, being carried into the mill by the reverse spiral liner at that end. The larger pebbles and mine-rock were charged at intervals through the man-hole, and any large rock is still so charged. The present practice is to charge No. 5 flint pebbles in this manner, after a new lining has been put in, sufficient in quantity to fill the pockets of the lining, and then to add smaller flint pebbles (No. 3 and 4) in excess of the mine-rock until a good grinding charge is secured; thereafter, a mixture of mine-rock and flint pebbles in the proportion of 3:1 is added daily as needed. The pebble charge is maintained at about two inches above the centre line of the mill, to give the best grinding with the lowest power consumption. If at any time the ammeter on the motor shows a rapid drop in power consumed, with an increase of coarse at the discharge of the mill, the proportion of flint pebbles to mine-rock is at once increased.

By using rock, selected from the harder portions of the ore, and costing very little to prepare, a considerable economy in pebbles is effected, without excessive liner wear or decrease in grinding efficiency. Imported pebbles cost about $75, delivered at the mill, while mine-rock costs but $2 or $3 per ton to prepare, and has the added advantage that it contains gold and silver, and therefore adds to the yield of bullion. Were the rock harder, it might be possible to eliminate the use of flint entirely, but experience gained during the War, when flint pebbles were very hard to obtain, showed that a good grinding charge could not be maintained with mine-rock alone and that under these conditions, the wear of the liners was abnormally great.

No gratings are used at the discharge end of the mills,



BETWEEN THE MINE AND THE MILL

as no trouble is experienced with pebbles or coarse rock working out; the reverse-spiral liner evidently prevents this. As has been mentioned, practically all the cyanide is introduced at the head of the mills, where a constant drip of saturated solution is maintained. At times it is necessary to add some lime also at this point, but only in case of an unusual decrease in alkalinity.

Wet Elevating. The two elevators handling pulp to the classifiers are practically identical in construction and operation. Since they replaced the two formerly in use, the material in these was used in their construction. They consist essentially of 12-in. eight-ply Silverton rubber belts working over 26-in. head pulleys and 24-in. boot pulleys, at a speed of 350 ft. per minute, the drive being from the top, as usual. The boot shaft, of 2.5 in. diameter, is carried in take-up bearings, and has stuffing-boxes to prevent leakage. The head shaft, 3.5 in. diam. and carried in plain boxes, carries an overhang pulley, by means of which the elevator is driven without the use of gearing. The pressed-steel buckets, spaced at 12-in. centres, are 4.5 by 5.5 by 8 in. No trouble is experienced with the packing of material in the buckets, which clear themselves beautifully at the discharge. The lift is about 25 ft. vertical, and either elevator has sufficient capacity to handle, if necessary, all the material to be lifted. The wear and tear is not great, but, naturally, some shut-downs for repairs are unavoidable. Taken all in all, elevators of this type would seem to offer the best means of elevating finely ground pulp of the character handled at this plant.

Primary Thickening. As has been noted, this is done in two thickeners, one preceding and one following the first agitator. The overflow from the first, or 30-ft. thickener, furnishes about 75% of the flow for precipitation during normal operations. As noted, there is no dilution of the flow to the second, or 25-ft. thickener; so the grade of the off-coming solution is about the same as that from the first thickener. In both, there is a sheet-iron baffle-ring projecting a foot or so above the surface of the charge at about 6 in. from the edge, which holds back the froth resulting from the use of lime. The overflow from both goes by gravity to the clarifier, but on occasion it can be sent by gravity direct to the zinc-boxes. As a rule, however, it has to be clarified to remove very fine slime held in suspension.

Agitation. The detail of the first agitation has already been described; it may be well, however, to refer more fully to the action in the Trent machine. The pulp and solution, with an admixture of atmospheric air, entering the arms through the central opening and distributing head at the bottom, is forced out through the nozzles, pointing downward and backward at an angle of 50° from the horizontal, the pressure causing the machinism to revolve. The pulp discharging over the bottom of the vat in annular circles of equal area, mixes thoroughly with the pulp in the vat, and through the circulation maintained as heretofore described, is slowly and gently carried toward the top of the charge, at all times intimately in contact with air. There is no violent or boiling action; simply a slow upward movement, with ebullition of small air-bubbles on the surface. When in action, the charge has the appearance of simmering. When the ratio of solution to pulp is kept at about 2:1, there is practically no settling of the larger or heavier particles; in other words, there is practically no accumulation at the bottom of the vat. The revolving unit is carried on a ball-bearing placed above the vat; and the whole can be lifted bodily in case it is necessary for repairs. The main difficulty in the internal operation arises from accumulation of wood-pulp, etc., in the nozzles, but when the incoming pulp is carefully screened, as it usually is, this is not so pronounced. The wear of the distributing mechanism is not great. As is usual with this class of machine, the greatest trouble comes from the centrifugal pump. As the pump used is one specially designed for the work, with hard-iron replaceable liners, extra-long gland and boxes, etc., the trouble is minimized. The greatest wear takes place on the runner and shaft, but the latter is made extra long and reversible, end for end. A shaft and runner last about eight months. The pump, driven

at 600 r.p.m. from a 5-hp. motor by a horizontal belt-drive, actually consumes about 4.2 hp. normally. Care must be taken to keep the pump well packed to prevent undue leakage.

After protracted shut-downs, no trouble is experienced in getting the agitator under way. When it becomes necessary to lift the mechanism, the charge is pumped out to about one-half, the mechanism lifted above the surface, and lowered again over the upward projection of the inlet pipe, which serves as a guide in operation. Altogether, this agitator has given very satisfactory service.

The second and third agitation operations are conducted as noted, in Dorr combined mechanical and air machines. The air for the central lift is furnished by the 10 by 8-in. compressor mentioned, at a pressure of about 18 lb. The machine is too well known to require detailed description here. The distinctive feature at this plant is the device for obtaining pulp transfer; it consists of a shallow pan, several feet long, with the top set just above the surface of the charge and connecting with a pipe leading through the side of the vat. The ends of the distributing-arms pass above this pan and discharge into it during the period of passage of whatever pulp may be flowing from them. It is obvious that the flow of pulp must be regulated so that the amount leaving the ends of the arms during such period is equal to the amount coming in. It has not been found difficult in practice to so regulate the discharge, and the arrangement has the advantage of ensuring at least one complete circuit for any given particle of ore before leaving the vat.

Secondary Thickening and Decantation. The four secondary thickeners are set in the form of a square, with the three diaphragm-pumps near the centre, side by side. From the pumps, launders run to the last agitator and the last two thickeners respectively, while they are connected in the same order with the discharges of the first, second, and third of the thickener series. The diluting solution, of course, is added in the launders and thoroughly mixed with the pulp before entering the vats indicated. The thickeners and pumps are driven from one line-shaft, in turn driven by a 3-hp. motor. The pumps are furnished with long connecting-rods and adjustable eccentrics, and each has a pet-cock below the diaphragm for the admission of air in regulating the amount of pulp lifted. Considerable trouble has at times been experienced by reason of diaphragms of poor quality, but with good ones, the normal life is from two weeks to a month. There is little wear or expense aside from this. The actual lift is short (probably not more than six feet), as the static head of the charge in the thickener is sufficient to life the pulp to within a few feet of the top of the vat, as is shown by the discharge from the last thickener of the series. In fact, where conditions permit it, better discharge can be had from a thickener by means of the static head alone than where lifting is necessary. Where counter-current washing is used, it is not practicable, however, as it is of greater importance to secure gravity flow of the counter-current solution by arranging the vats as they are here arranged, with a two-foot drop between vats from the last to the first, or six feet of drop in all. The arrangement here used permits of varying the application of the washing solutions to fit the needs of the case.

The pulp as it leaves the last thickener has a specific gravity of from 1.3 to 1.4, the thickening in the other tanks being carried as nearly as possible to the same degree.

Replacement. The three Trent replacers in use are identical in size and equipment, and the action in each is the same. This action has been already described with reference to the first, interposed in the treatment in advance of the second agitation. Receiving as it does the pulp that has been diluted with a low-grade gold solution from the overflow of the others, the overflow from it is of sufficient grade to be returned to storage. Since all three take barren solution in the pump-suctions, the cyanide content is practically the same in the overflows from them all. The amount of solution introduced at the bottom is kept slightly in excess of the amount drawn off from the pump-discharge for passing onward with the pulp, which results in a slight upward movement of solution in the charge; not enough to hinder the ore particles from settling, but sufficient to prevent any downward movement of the solution coming in with the pulp at the top and to secure an overflow slightly in excess of the amount of such solution. Of course, it is impossible to prevent diffiusion to a certain extent, and the slight upward movement in the charge results in the fine slime rising to near the top of the charge. The line of demarkation between slime and clear solution is usually within an inch or two of the top. There seems to be no advantage in attempting to carry it lower, and there may be less diffusion in this case.

The use of a tapered vat is of decided advantage, as it gives increased settling-area, with decrease of the upward movement as the top is approached, with decreased power consumption, owing to a smaller machine being used than would be necessary in a straight vat, and with more concentrated and cleaner work at the bottom. Such a vat is just as easy to build as a regular straight-sided vat, and has been just as easy to maintain.

The remarks anent pump operation under the heading of agitation, apply with equal force to the circulation maintained in replacement, except that in this case, the pumps are smaller and are operated at considerably less speed. They are of the same type and make, with solution-protected glands, etc., and are driven individually from motors by belt. While the motors are each of five horse-power to provide extra power in case of emergency, the actual indicated power delivered is considerably less than four horse-power as a rule, for each one. As regards relative position, the three replacers are set in a row, the top of the first being two feet higher than that of the other two, which, as remarked, can be used in series, in parallel, or separately, as occasion may require.

Filtering. Under this head is included the final thick-

ening, as this is but a preliminary operation in preparing the pulp for the filter, removing at the same time a portion of the incoming solution from the last replacer. This thickener, like the last of the regular series, discharges by static head. It serves for storage and as a means of obtaining a steady feed to the Oliver filter, on which the final solution-wash and the only wash-water is applied. The effluent solution from these washes, low in gold and cyanide, is raised by a centrifugal pump to a separate storage at the head of the mill for use in the washing-plant. The amount of water-wash here applied is regulated by the amount that the entire solution-circuit will stand without running solution to waste. As this is quite limited, it is essential to apply the water-wash in the most efficient manner, to obtain the maximum of washing with the minimum amount of water.

Since lime is used, it is necessary to give the filter an acid wash at times. This is done by emptying the tank of the filter and then running on dilute hydrochloric acid through the spray-pipes with the vacuum maintained, whereby the acid is drawn through the filter and returned to the tank above the filter, where the required strength of acid is maintained by further additions. This practice has eliminated much of the scrubbing, has kept the pipes clear of lime incrustations, and has saved much of the wear on the filter.

The use of this filter, which is of the latest type and an unusally large single unit, is apparently justified by the resultant saving in dissolved metal otherwise unobtainable as the plant stood, as well as by the increased treatment made possible in the preceding units. Its operation has been considerably hindered by shortage of power, but it is hoped that data based on more extended and steady operation may soon be available.

Precipitation. The pregnant solution from the primary thickening is divided as equally as possible among the 12 lines of compartments, the head ones being filled with excelsior and the others with zinc-shaving. It has been found that by the use of excelsior in this way, a final clarification is obtained, and if there is any tendency for lime-salts to precipitate, they deposit on the filaments of the excelsior instead of on the zinc. Several times each month the excelsior is shaken up and washed thoroughly, the compartments containing it washed out, and the excelsior replaced.

Lead acetate to the extent of a few pounds per day is added to the zinc-boxes to ensure good work. Formerly this was added entirely in the first compartments containing zinc, but now it is added all down the line, a little to each compartment. This has resulted in a decided improvement in the precipitation. It may be remarked here that there is no addition of lead-salts at any other point in the treatment, except that the used cupels from the assay-office are fed in the tube-mills from time to time. There seems to be practically no formation of soluble sulphides at any stage of the treatment.

The zinc is prepared in the usual way by cutting from sheets on a lathe, but it is not added daily, nor are the compartments, once packed after a clean-up, disturbed until the next, unless there should be some special reason for it. The zinc filaments, cut one eight-hundredths of an inch in thickness, drop into a box one by two feet, and one foot deep, until it is filled; they are then pressed down into a pad about two inches thick, and removed and stored until needed. When used, these pads of filament are laid in the boxes in pairs, alternately lengthwise and crosswise, until the compartment is filled.

Normally, something over 400 tons of solution undergoes precipitation in 24 hours. The effective space of the compartments containing zinc is about 430 cubic feet, which gives practically one ton of flow per cubic foot per 24 hours, as established by Alfred James. The grade at the head is usually between $3 and $4 per ton and often more, while that at the foot is reduced to a few cents. The actual value precipitated per day is quite accurately determined by means of the method of solution measurement previously described, in conjunction with the daily assays of head and foot solution. The method mentioned was developed at the Tom Reed mill by Mr. Jones, superintendent.

Clean-up. These are made bi-monthly on the first and fifteenth. The procedure is as follows: The solution is shut-off from a line of compartments and an iron box, two by four feet, and one foot deep is placed crosswise of the line and is half-filled with clear solution. Two wooden trays, each 22 by 20 in., and 9 in. deep, with a 20-mesh steel screen on the bottom, are suspended in this box. The zinc in the first compartment is first shaken thoroughly in the solution filling the compartment and then transferred to the trays for final washing. The trays are given a jigging motion, which separates the precipitate and 'shorts' from the longer zinc. These accumulate in the box, below the trays. The contents of the compartment are washed out through a plug in the side into a launder leading to the refining-room, the compartment being then thoroughly washed with fresh solution and the supporting screen replaced. The coarse zinc remaining in the trays is then replaced, and the second compartment handled similarly, except that the zinc remaining in the trays from this one is added to that in the first compartment until it is filled. Any left-over is placed on the screen of the second. In the following compartments, the zinc is washed in the compartment and moved up. Each compartment when empty of zinc is discharged into the launder and washed thoroughly before replacing the supporting screen and introducing the zinc. After all the old zinc has been moved forward, the space remaining is filled with pads of new zinc, placed as noted. This procedure was adopted after trying many other methods, and has resulted in the production of a minimum of 'shorts' and a great saving of time and labor.

All the material carried by launder to the refinery passes onto a 30-mesh steel screen. Any too coarse to pass is added to that remaining in the iron box mentioned, after the latter has been washed by decantation into the launder. This accumulation of 'shorts' is placed in successive charges in a barrel for cleaning. This barrel, made on the ground from a 60-gal. oil-drum, is lined with

steel plate and has a man-hole and cover, and on the ends it has flanges into which are screwed 2-in. pipes serving as trunnion-bearings. By means of a small pipe the solution is introduced through one of these trunnions in a steady stream during grinding, and flows out through the same trunnion, the other trunnion being closed. Grinding is carried to the point where this solution comes off practically clear, when the remaining zinc is returned to the upper compartments. With the product so treated at the principal clean-up in the first of the month, a charge of about 75 lb. of small flint pebbles is carried in the barrel, in order to get as close a clean-up as possible. At the mid-monthly clean-up, this pebble charge is omitted. It seldom happens that there is sufficient accumulation of 'shorts' to require acid treatment to get rid of it, because the boxes will take a considerable amount of the cleaned short zinc without becoming clogged.

Refining. From the accumulating tank, the product is drawn by a rotary pump into a 20-frame clean-up press, the pump moving the clear solution back to the head of one line of zinc-boxes. That first drawn off from the top of the tank is practically free from zinc, but is low-grade. After being dried as nearly as possible by means of compressed air, this is discharged and placed in pans and dried in an oven to a point short of dusting; it is then pulverized and held for mixing with the higher-grade product to follow. This product is handled in much the same way, except that it is heated to redness in the oven. After cooling, it is carefully pulverized to minimize dusting and thoroughly mixed with the somewhat damp low-grade product. After putting through a ¼-in. screen this mixture is weighed, mixed with flux, and melted in successive charges in two Case oil-burning furnaces, in No. 125 graphite pots. When fusion is complete, each charge is poured by tipping the furnace, the first 80% discharging into a pit filled with water and containing a suspended wire basket, and the remaining 20% into a conical mold. The granulated slag from the pit is collected, dried, crushed, and ground, and later concentrated on a small table for removal of fine gold and matte, then sealed in 5-gal. oil-cans and held for subsequent shipment to a smelter. When sufficiently cool to handle, the cones from the molds are dumped, the button of metal, and any matte there may be, is removed, and the remaining slag crushed and added (while still hot, if possible) to the succeeding charges. The metal is held until the run is finished and then re-melted into bars of about 200 oz. Troy. It assays ordinarily about 600 fine in gold and 250 in silver.

When sufficient matte has accumulated to make a charge, it is reduced in one of the Case furnaces, using for this purpose a crucible nearing the end of its service, thin at the top, but still having a good bottom. The charge is made up of finely divided matte, assay-slag, and flux, well mixed, and is brought to a high degree of heat; then scrap-iron is stirred in until no more will be absorbed. The heat is raised as high as possible and the charge poured into a conical mold. After cooling, the matte, greatly reduced in value, is broken off, crushed, and packed separately for shipment while the resultant bullion is melted into bars for separate shipment. This bullion usually assays about 250 fine in gold and 450 in silver and contains considerable lead, the proportion depending, of course, on the quantity and character of the assay-slag used. By weight this low-grade bullion is about 15% of that of the regular bullion. All the bullion goes by mail to the Mint at San Francisco, unless there is a demand for it at a premium in the local market.

Preparation of Lime. Burned lime is furnished from local sources at about $20 per metric ton delivered at the head of the tram. Owing to climatic conditions, it is not practicable to burn and handle lime except in the dry season, so a supply adequate for the year is received during these months, transferred over the tramway to the mill in sacks, slaked, and run into open pits as hydrated lime. When a pit is filled the surface is covered with a layer of sand, which maintains the lime in the form of a thick paste until needed. When a pit is opened, the contents are removed as required by cutting from the edge of the bed, usually about four feet deep, so as to expose as little surface as possible to the air. It is added to the mixers in the form mentioned, and in them emulsifies quickly and thoroughly, while any particles of unburned lime or foreign matter are ground by the rollers of the mixers, leaving no accumulation in the pans. The mixers, built on the ground, consist essentially of steel pans, four feet in diameter by two feet high, with a 2-in. discharge-pipe set 10 in. above the bottom, and two rollers, each 6 by 10 in. on radiating arms from a central upright shaft, driven from overhead by bevel-gearing. They take very little power to operate and have proved satisfactory. About ten pounds of lime per ton of ore is required to maintain proper protective alkalinity, which tests at about 0.28 in the zinc-boxes.

Sampling. As previously noted, no sampling is done on the ore as it enters the mill except to determine the moisture. At the period when all the ore was stamped, numerous trials were made on sampling the stream of ore through the feeders, but the results were always so erratic as to be of no value, and the method involved a great deal of labor. Sampling the discharge from the mortars was also tried, with a correction for the estimated amount of value dissolved in stamping. The results from this, while not so erratic as from the former method, were not close enough to be dependable. With the introduction of washing with weak solution, the problem was further complicated, so the present practice is to take frequent pulp and solution samples at various points of the treatment, measure the flow of the solution and estimate the incoming value as closely as possible. The tipping automatic sampler mentioned was soon discarded as being unreliable, and careful tailing-sampling by hand was substituted. Careful testing is done on each shift in the mill for cyanide and protective alkali at various points.

The total consumption of cyanide (99.5% NaCN) in the treatment is about one pound per ton of ore treated. The major portion of the chemical loss appears to be in the tube-milling.

Moving Sacramento Hill

One of the most important mining projects in progress in the South-West today is the razing of Sacramento Hill at Bisbee, by the Copper Queen branch of the Phelps Dodge Corporation, to recover approximately 25,000,000 tons of low-grade copper ore that is under the mountain. Within 20 years this sentinel of the Warren district will have been entirely obliterated and the bulk of its contents sent to the smelter or mill. About a billion pounds of copper will have been recovered in the process.

Since work was started in 1917, more than 5,500,000

SACRAMENTO HILL, AT BISBEE, IN OCTOBER 1917

SAME VIEW AS ABOVE, PHOTOGRAPH IN OCTOBER 1920

cu. yd. of material has been moved. When the work is finished there will be, in place of the hill, two pits, one about 1500 ft. diam. and 420 ft. deep, and the other about 2200 by 1500 ft., and 440 ft. deep. These data were obtained from exploration by churn-drilling.

The total amount of material to be removed is about 40,000,000 cu. yd., slightly less than one-third of which by volume will be ore. It is estimated that it will take 16 years to fully complete the work. Seven steam-shovels are employed in the operation, and are served by 15 'dinkey' locomotives, hauling trains of four to six dump-cars. Until the recent reduction in operations was put into effect, the company was handling about 225,000 cu. yd. per month. The hill is being reduced by means of horizontal benches which are 60, 45, and 35 ft. in height. About 16 miles of railroad track was laid to connect these benches with the waste dumps and the concentrator.

The ore from the hill will be divided into three classes. All above 3½% copper will be sent directly to the smelter; ore averaging between 1% and 3½% will be sent to the concentrator; and all ore below 1% copper will be treated by the heap-leaching process. The concentrator and crushing plant are now under construction. The ratio of concentration will be about 4:1, and the concentrate will average between 7 and 8% copper.

The razing of Sacramento hill necessitated demolishing the former power plant of the Copper Queen, which was situated at one side of the hill. The company has completed the construction of a power-line from the station at Douglas to the mines at Bisbee, carrying 4000 kw. An auxiliary plant of Diesel engines, two of 1000 hp. and two of 2000 hp., have been installed for emergency use. The work will necessitate also the abandonment of the Sacramento shaft, the present main hoisting shaft for all underground operations, and the substitution of the Dallas shaft for this purpose.

THE QUINCY MINING CO. recently placed in operation its new Nordberg hoist at No. 2 shaft. It is the largest hoist in the world. It has a winding capacity of 10,000 ft. of 1⅝-in. rope reaching down an inclined shaft to a vertical depth of 6600 ft. When winding the rope down the second cone of the drum, it has a capacity of 13,300 ft. reaching to a vertical depth of 8600 ft. The hoist operates in balance, raising a load of 20,000 lb. per trip, and is designed for a rope-speed of 3200 ft. per minute. The drum is of the clindo-conical type which is so familiar in the Lake Superior copper district. There are eight impulses per revolution and together with the great mass of the drum, which weighs 516,000 lb. without the shaft, practically all pulsation in the rope is eliminated. The drum is built up of 48 sections securely bolted together and thoroughly trussed within. This arrangement prevents any deflection of the drum-shaft. The hoist is fully protected by an improved safety stop, whereby the throttle-valve is automatically closed as the skip approaches the landing. In case of overwinding, the engine is also reversed and the brakes are applied automatically. The hoist cannot be started in the wrong direction. Over-speed is prevented by a speed governor which controls the cut-off cams of the valve-gear. The total weight of the engine with condensing equipment is 1,765,000 lb. The engine covers a floor space of 60 by 54 ft. and stands 60 ft. high from the bottom of the foundation to the top of the drum. The foundation under the hoist and condensing equipment contains 3000 yards of concrete. The weight of the skip is 10,000 lb. The weight of the 10,000 ft. of rope is 41,500 lb. The time required for one trip of 10,000 ft. is 4 min. 8 sec. The hoist is housed in a concrete and steel reinforced structure.

Washing Coal

The benefits that may be derived from coal-washers is illustrated by the following instances cited by the U. S. Bureau of Mines. A coal-mining company in the State of Washington for many years has been discharging sludge into a pile near the mine, which the company's engineer recently estimated at 150,000 tons. Engineers for the Bureau took large samples of this material and made washing experiments on a coal-washing table. It was found that the ash content could be reduced from approximately 30 down to 17%, with a recovery of about 75% of the coal. As a result of these tests and the recommendations made by the engineers, the owners of the mine are erecting a washing-plant equipped with five tables for treating the entire pile of sludge. The material in this pile now has a recoverable value of $2 per ton, or a total value of $225,000. As a further example, it was found in a study just concluded at the plant of another coal company that the raw nut-coal contained 24% ash. After washing in a jig, the washed coal was found to contain 23% ash, and 15% of the feed was discharged as a washery refuse. It was decided to study the action of the jig, using the improved float-and-sink test as a control. Float-and-sink tests, using 1.55 specific gravity zinc-chloride solution, showed that 81% of the feed to the jig floated with an ash content of 14%; 82% of the washed coal floated with an ash content of 14.9%; and 62% of the refuse floated with an ash content of 16%. These results indicate that the washed coal was improved by only 1% decrease in ash, and the good coal lost in the refuse amountel to over 9% of the feed or 11% of the total good coal in the feed. After several days experimenting with the jig in which the length of stroke was gradually increased from 2⅜ in. up to 3⅜ in. and the rate of feed and refuse discharge properly determined and adjusted, the following improvements were observed: The ash in the washed coal was reduced to 16%, with a recovery of 86%; 92% of the washed coal and 25% of the refuse floated on a 1.55 solution, the loss of good coal in the refuse being reduced from 9.3% to 3.5% of the feed. Since approximately 250 tons per day is washed on this jig, the saving effected amounts to about 17 tons per day, which, at $4 per ton, is worth $68. Services of two men formerly employed to pick the rock out of the washed coal were also dispensed with, thereby affecting a further saving of $13.60 per day, or at the rate of 6 cents per ton of coal treated.

REVIEW OF MINING

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

EXPLOSIVES PLANT UNDER CONSTRUCTION.—NEW VEIN FOUND AT PIONEER.

BISBEE.—A large plant for the manufacture of dynamite is being constructed in the San Pedro valley, about seven miles south of Benson, and will be ready for operation early next summer at the present rate of progress. The organization that is back of the project is known as the Apache Powder Co., and is reported to include many of the mining companies of the State. Practically all of the powder manufactured will be used by mining companies of Arizona. The plant will occupy a tract of 500 acres.

Hoisting through the Briggs shaft of the Calumet & Arizona Mining Co. was discontinued on Sunday, December 5. Operations in the mine itself will be continued, but only during the day shift, the ore being taken out through the Junction shaft. This action was taken to consolidate the work and reduce unnecessary expenditure, and will not result in the laying-off of any men. A few men will be transferred to the Junction mine. The installation of a new Sturtevant blower, capable of handling 100,000 cu. ft. of air per minute at 4-in. pressure, has been completed on the 1400-ft. level of the Briggs and it is in operation, being used partly in connection with the new ventilation system of the Briggs, and partly to supply more air to the Junction and other mines of the C. & A. company.

PHOENIX.—Vigorous efforts will be made by members of Congress from Arizona to secure the enactment of a measure exempting patented mining claims from assessment work during the year 1921. It is asserted that many owners of mining claims, under present conditions, find it impossible to secure the necessary funds for assessment work, and that for that reason such action by Congress would be justified.

RAY.—A new vein of rich silver ore, reported to average 100 oz. per ton at the surface, has been discovered on the property of the White Metal Mining Co. at Pioneer. The new vein parallels the famous Pioneer vein. It is to be tapped as soon as possible by a tunnel, work on which has been started from a point across the creek from the company's new mill.

JACKSON, AMADOR COUNTY, CALIFORNIA

CALIFORNIA

DEVELOPMENT AT ARROWHEAD RICO MINE.

UBEHEBE.—Statements made by Sol Camp, manager of the Arrowhead Rico's mine, and also disinterested persons, make it evident that the company has claims holding great possibilities and the fact that ore is being broken for shipment through Bonnie Clare, Nevada, 50 miles distant, is attracting wide attention. The Rico owns nine claims that were bought from Archie Farrington of Big Pine. A drift tunnel entered the ore-shoot at the 50-ft. point and it has been continued 25 ft. more in ore 7 ft. wide and assaying $86 to $100 for this width.

The average metallic content is 45% lead and 40 oz. silver. Two men in the tunnel, without stoping, have broken 80 tons of ore and there is no indication that the end of the shoot is near. This tunnel is now 80 ft. from the surface and another, which should cut the vein at a depth of 300 ft., has been driven 170 of a total of 500 ft. to the vein. An air-compressor has been bought for use in this work. The orebody is a replacement of soft readily soluble lime that is considered ideal for the existence of silver and lead. The lead is in both sulphide and carbonate form and the silver is found with both, the galena in places containing as high as 100 oz. Two men shovel four tons daily and the 80 tons has been broken with 50 lb. of powder. Fifty tons has been sacked and at the present rate of hauling three carloads can be sent to Salt Lake City monthly. It is planned to continue shipping at this rate at least until the lower tunnel can be completed. The cost of hauling to Bonnie Clare is $15 per ton and the railroad rate will be about $12. The company has ample funds for all purposes, according to Mr. Camp, having been financed in the East. He says the first payment on the purchase price has been made and he is confident the money for the other payments can be derived from shipments.

COLORADO

RICH ORE FOUND AT ASPEN.—MODOC CONSOLIDATED HAS NEW HOIST.

ASPEN.—Confirmation of the reported find in the Park tunnel on the Celeste claim has been secured from officials. The tunnel on November 28 exposed ore in the breast assaying 11 oz. silver and, two days later, samples taken across a 36-in. streak assayed 442 oz., 419 oz., and 51 oz. An average for the entire vein gave 150 oz. silver per ton. The vein lies in brown lime, east of the porphyry and 200 ft. deeper than the old Tourtelotte park workings and at a point 2900 ft. from the tunnel portal, in virgin territory.

CRIPPLE CREEK.—The Reva Gold Mining Co., operating the Rose Nicol company's Battle Mountain property under a long-time lease, recently extended for a 2½-year term, has found rich gold-silver ore at the tenth or 1000-ft. level. The Roosevelt tunnel traverses the Rose Nicol from west to east at an approximate depth of 2000 ft., and the Reva management plans to operate from the tunnel-level. The working force, at present about 12 men, will be increased by adding a second shift.

United Gold Mines company lessees, operating the Hardwood, are accredited with producing close to $150,000 in the past 90 days. Settlement on the last three 30-ton cars, was as follows: $175, $170, and $150 per ton, while the average net mill-return has been around $5000 per car. This ore has been mined from a shaft 40 ft. deep with winze 21 ft. The orebody is 5 ft. between walls and not more than a couple of wagon-loads of waste has been dumped. The ore has been hoisted by windlass. The most powerful electric hoist in this district is being installed at the No. 2 or Last Dollar shaft of the Modoc Consolidated Mines Co. It was manufactured by a Cleveland firm and has a hoisting capacity for 2500 ft. The estimated cost installed exceeds $35,000.

The former plant at the Gold Coin shaft, believed the most costly in this district, constructed at a cost of $260,000, is now being dismantled and the building, a steel and pressed-brick structure in the city of Victor, will be wrecked. The hoist and compressor have been sold, it is understood, to the Portland company. The Granite Gold Mining Co. has centralized operations at the Dillon shaft, on Battle mountain. Directors of the Golden Cycle Mining & Reduction Co. have declared a two-cent dividend, $30,000, payable December 10 to stock of record November 30. With this payment the total paid will be $9,513,330. Cresson directors met and passed the December dividend.

Zinc ore assaying from 30 to 45% has been found and is now under development at the Riley-Murray lease on the Lilian, in Iowa gulch. Ore-bins have been erected and shipments to the Canon City plant started. A raise carried 40 ft. is reported to be in ore all the way. Keystone lessees, operating in the Sugar Loaf district, are shipping steadily to the smelter a good grade of gold-silver-lead ore.

SILVERTON.—A rich find is reported at the White Cloud mine, above Ironton. Five feet of ore exposed, with no foot-wall in sight, samples $75 to $108 per ton with bornite showing in the ore. Development is expected to open a strong and rich ore-shoot.

BRECKENRIDGE.—Lessees on the Brooks-Snider, Shock hill, are shipping gold and silver ore to the A. V. smelter at Leadville. One-half ton of high-grade gold ore was shipped last week and a carload of 70-oz. ore was shipped by another set of lessees.

Horn Tunnel lessees shipped a car of silver ore to the A. V. smelter last week. The tunnel is located on a spur of Mount Guyet, near Georgia Pass. The majority of the dredging boats have suspended operations for the winter, but the boats on the Blue river below Dillon will continue.

CENTRAL CITY.—Pitchblende, the uranium ore, is reported found on the Gold Rock in the Russel district. Sinking will shortly be started for a 125-ft. lift on the Hampton mine. Operations will be continued during winter by the Rich Charter Oak company on the Jack Rabbit group in the Twelve Mile district, Gilpin county.

The Buell property is shortly to become active under a bond and lease negotiated by Denver parties.

OURAY.—The Hidden Treasure Mining Co. recently organized in Washington, headed by Benedict Crowell, has acquired machinery and equipment formerly used by the Silver Mountain Mining Co., and is installing it. The property was purchased from Mrs. Evelyn Walsh who acquired it from the estate of her father, the late Thomas F. Walsh. The consideration paid has not been made public.

TELLURIDE.—A good grade of gold-silver-lead concentrate is turned out at the Matterhorn mill of the Valley View Leasing & Mining Co., and a two-car shipment to the Durango smelter was loaded this week.

MICHIGAN

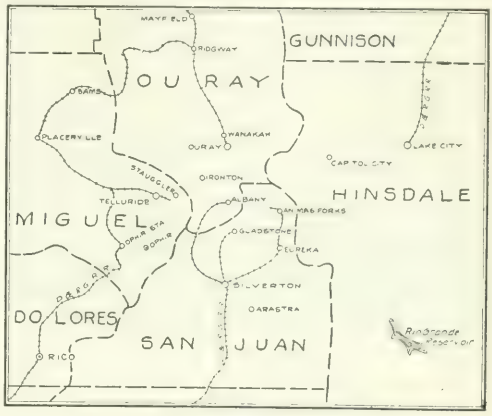
BRADLEY STOUGHTON TALKS ON COPPER INDUSTRY. EQUIPMENT REMOVED FROM OSCEOLA LEVELS.

HOUGHTON.—Bradley Stoughton, of New York, secretary of the A. I. M. & M. E., stated in an interview here that he was not as pessimistic over the copper situation as many men seem to be. "There is a good deal of copper in storage, it is true, but I hear of any number of big electrical projects now getting under way or planned for the immediate future which will require huge amounts of copper", said Mr. Stoughton. "The exchange rate is against us and Europe cannot buy our copper now, but I see many factors entering into the situation which point to better times ahead." Mr. Stoughton stated that Sweden is considering the electrification of its railroads and now has a representative in this country looking into the project. He believes that Sweden will soon be in the market for a large amount of copper. Instead of exporting money, Mr. Stoughton believes that the Government should establish or encourage large loans in this country to be spent here in behalf of foreign countries for raw materials and manufactured products. This would eliminate the inequality of exchange which is now a detriment and a brake to industry. "The trouble with the United States today is that we have too much money," Mr. Stoughton said. "We are too rich and the other nations so poor that they cannot buy our surplus production."

The Quincy Mining company has announced a reduction of 15% in all wages and salaries at the mines, mill, and smelter, effective December 1. It is stated, however, that there will be no further curtailment of the present small operating force.

Wolverine's production is gradually increasing, with the yield 17 lb. per ton. Accordingly, another head will go into commission in the Wolverine mill in two weeks. Repairs in No. 4 shaft are practically complete and the resumption of hoisting there will permit a greater 'rock' output from the mine than at any time in recent years.

With operations on the Osceola lode of Calumet & Hecla at a standstill, all efforts are being directed toward the conglomerate. From appearances, it will be a long time before the Osceola shafts are re-opened. The tramcars, motors, pumps, drills, and even piping below the 24th level of at least one of the shafts are being taken out. On a low market, with the comparatively low yield of Osceola lode 'rock', the operation of this department is expensive. A recovery of 16 or 17 lb. of copper is final and there is no hope of re-treatment of tailing as has proved so profitable on conglomerate 'rock'. The construction of the underground haulage-way in the conglomerate branch will not be delayed, though this project for some months has been moving along slowly. The tunnel in itself is small, permitting the employment of only a small force at a time and, as it extends, time must be given to line the walls and roof with cement. The tracks are laid quite close to the terminal and in one or two places cross-cuts have been driven through the amygdaloid vein which the tunnel is penetrating and the Calumet conglomerate lode. At No. 12 shaft, raising is going forward and the connection will have been made long before the tunnel is driven to the ultimate terminal. The haulage-way will connect all of the conglomerate shafts and will permit deep mining at a minimum cost. All 'rock' will be hoisted, upon completion of the tunnel, through the Red Jacket shaft. Construction at the Tamarack reclamation plant is proceeding and steel work will be started early in the spring, according to present plans. The steel is now being shaped and all preliminaries are receiving attention so there will be no delay once actual construction and installation of equipment gets under way. Ahmeek's daily 'rock' tonnage is sufficient to keep five of the eight stamps in the Ahmeek mill in operation. Under the curtailment plan, Ahmeek is settling with as many men without dependents as possible and on the other hand is absorbing a number of married men from other Calumet & Hecla mines. As a result there will be no reduction in the production of the mine. The output, it is expected, will be kept within present figures and not less than five heads in the mill will be operated.



SOUTH-WESTERN COLORADO

NEVADA

FLORENCE STOPS WORK ON COMPANY ACCOUNT.—ALLIED MINING & MILLING CO. HAS COMPLETED 50-TON MILL.

GOLDFIELD.—The Florence has stopped work on company account. The only work being done was in the south-east cross-cut on the 258-ft. level, which had reached a point 1350 ft. from the shaft. This is 300 to 400 ft. from the objective, a vein that may be the southern extension of the main ore-channel of the district. The leasing policy of the company will be continued. F. Sommer Schmidt, general manager, says: "The controlling interests in general are willing to raise money to continue the plan of development until it has been brought to a point where it will be either a success or a failure, but all of the interests are not in a position to help support the work at this particular time, and the result is, some other

financial arrangement will have to be made." The Consolidated will resume the leasing policy next year.

MONTEZUMA.—The Montezuma Silver Mines Corporation has stopped work because of adverse financial conditions, according to Edwin S. Giles, manager. Three men were employed in re-timbering the Caracas shaft.

SILVER PEAK.—The plant of the Silver Peak Chemical Co., designed to produce 25 tons of potash alum and an equal quantity of flour of sulphur daily, has been started. It cost $200,000. The company plans to employ 40 men in the mine and mill. It is reported to have contracts for the output for 18 months. Potash alum is used largely in the motion-picture industry for drying film and in the manufacture of dye and paper. The main use for flour of sulphur is in mixtures for spraying fruit trees.

RAILROAD SPRINGS.—The Allied Mining & Milling Co. has completed a 50-ton concentrator and tests have given a product containing 50% lead and 10 to 20 oz. silver, according to David Trepp, manager. The Allied is in the Railroad Springs district, 33 miles south of Goldfield, the supply point. The plant consists of a crusher, coarse and fine grinders, and a Universal table. Water for the mill is pumped 2000 ft. in an exposed pipe and freezing prevents continuous operation during the winter. A classifier and another table will be added in the spring, according to Mr. Trepp, who says he will employ 15 or 20 miners as soon as the concentrator can be operated at capacity. There is 10,000 to 12,000 tons of ore blocked-out in the mine that should be treated at a fair profit.

KLONDYKE.—A body of silver-lead ore 70 ft. long, 10 ft. wide, and assaying $30 is reported to have been opened at a depth of 60 ft. by the Knox Divide, which recently bought the MacNamara mine for a price said to have been $40,000. Men who have talked with officials at the mine say the company is preparing to ship 100 tons of ore daily to Millers through Klondyke station on the Tonopah & Goldfield railroad, to which a road is to be built. These men say a compressor has been bought for use in sinking a new shaft and that the company plans development on a good scale. The ore contains equal quantities of gold and silver. Edwards and Maloney, who have a lease on the Original Klondyke, have been shipping for several months and the present rate is 30 tons daily. It is reported that they have pending a deal for the sale of their lease and the mine.

SPRUCE MOUNTAIN.—The Spruce Monarch has shipped in the last year 7464 tons of ore with a content of 21.95 oz. silver and 17.7% lead per ton, according to A. H. Elftman, a consulting engineer of Tonopah who visited the mine recently. The gross value of the ore was $250,000 and the net value was $112,000. There is blocked out in the mine 20,000 tons of ore assaying 20 oz. silver and 17% lead and 30,000 to 40,000 tons assaying 10 to 15% lead, according to Mr. Elftman. Shipments are being made to Salt Lake City at a rate of 30 to 50 tons daily. The Ada H. is preparing to start shipping.

UTAH

UTAH COPPER COMPANY APPEALS DECISION IN SUIT WITH POWER COMPANY.

SALT LAKE CITY.—Judge Joshua Greenwood, president of the State Public Utilities Commission of Utah, will attend the hearing at Washington, D. C., December 13, when the railroads of this State will make their final appeal before the Interstate Commerce Commission for permission to increase freight rates on coal and low-grade ores, which the Public Utilities Commission refused to grant. The case was partly heard at Salt Lake City during the early part of November, and the remainder of the hearing will consist of oral arguments.

The U. S. Bureau of Mines at the University of Utah has been designated as the 'Intermountain Experiment Station' by the Department of the Interior, according to Thomas Varley, superintendent of the local bureau. The bureau will have under its jurisdiction Montana, Wyoming, Colorado, Utah, and parts of Nevada and New Mexico. The work at the local station is principally in connection with the metallurgy and ore-dressing of lead, copper, silver, and zinc.

At a meeting of the directors of the Utah Copper Co. in New York on December 3, the regular quarterly dividend of $1.50 per share was declared, payable December 31. This will call for the payment of $2,436,735, and bring the year's disbursements up to $9,746,940. On December 2 the company appealed to the Supreme Court of Utah for a review of the power contract decision made in October by the Public Utilities Commission, as a result of which the company was placed on a schedule rating for power service. This almost doubled the amount previously paid by the company to the Utah Power & Light Co. The writ has been set for hearing December 16, and other large consumers, holding special contracts, are expected to file similar petitions. It is thought that the Supreme Court will amalgamate all such hearings and set a later date for the hearing of arguments.

GOLD HILL.—The Western Utah Copper Co. is now shipping 200 tons of low-grade lead-silver-iron ore per day, according to S. M. Soupcoff, engineer for the company. A drift is being driven to the south-west on the 700-ft. level, which is expected to open additional ore in that part of the company's holdings. A cross-cut being driven on one of the upper levels is expected to reach the ore soon, and shipments will then be started from that point.

PARK CITY.—The new office building of the Judge Mining & Smelting Co., and the new bunk-house, are nearing completion and will be ready for occupancy by Christmas. The bunk-house is equipped with change-rooms and shower-baths. Conditions at the allied properties—which includes the Judge, the Daly-West, the Park Utah, and the Daly—are reported as satisfactory. For the first time in years there is a surplus of labor. More than thirty lessees are working in the mines under the supervision of W. J. Wallace, formerly in charge of operations at the company's smelter.

During the week ending November 27, the Judge companies shipped 829 tons of ore and 50 tons of premium spelter; Silver King Coalition, 453; Ontario, 580; Keystone, 365; Naildriver, 60; making a total of 2137 tons. During the month of November the total output of all mines in this district was 7694 tons.

Clarence Bamberger, assistant manager for the Ontario Silver Mining Co., reports that the property is having trouble with water. On the 2000-ft. level, while development work is gratifying and ore is being uncovered, progress is handicapped by a constantly increasing flow of water. A short time ago additional pumps were installed to handle the water from this level, but the capacity of the pumps is practically exhausted and larger pumps are now being contracted for that will solve the water problem.

EUREKA.—Development work has been resumed on the 1800 and the 2000-ft. levels of the Eagle & Blue Bell property, according to William Owen, superintendent. This work was stopped several months ago, owing to labor shortage, but there is now an ample supply of good miners. Within a few months it is expected that these levels—the lowest in the mine—will be producing. The ore recently struck on the 1350 and 1550-ft. levels at the Victoria mine, owned by the same interests, is being developed. This gives four levels in the Victoria from which ore is being extracted, the other two being the 1000 and the 1200-ft. levels.

The Centennial-Eureka company has let a contract for driving a drift on the 1800-ft. level. This drift will be sent entirely through the Grand Central holdings for the purpose of reaching some of the Centennial Eureka's ground which is too far from the old workings to permit of profitable working. Two shifts will be employed in driving the drift.

Preparations are being made to re-open the deepest workings in the Bullion-Beck mine. Some 12 or 14 years ago considerable work was done on the 1300-ft. level, which is the deepest point reached by the shaft, and also on the 1500-ft. level which is reached by a winze from the 1300. John Enlund, superintendent, reports that recent developments lead him to believe that there is ore at this depth. There is some water in these deep workings, which the company is arranging to pump out.

At the Lehi Tintic property the small hoist, utilized in sinking the shaft, has been replaced by heavier equipment, and sinking has been resumed. The shaft now has a depth of 110 ft., and with the new equipment, a depth of 1200 to 1500 ft. can be attained.

BRITISH COLUMBIA

ORE-RECEIPTS AT TRAIL. — NEWS FROM GOLDEN.

VANCOUVER.—Through the Department of Industries, the Provincial government has granted a loan at 6% interest to finance the amalgamation of the Port Moody Rolling Mills and two small electric iron-furnaces, that at present are re-melting scrap metal. The amount of the loan is $250,000 and the amalgamation is to be known as the B. C. Steel Works, Ltd.

STEWART.—Scott Benson, who is interested in the Tonkin group, on Fish creek, states that in an interview with R. J. Summers, Surveyor General and Acting Governor of Alaska, Mr. Summers stated that the territorial government had decided to appropriate $15,000 for the construction of a branch road from Fish creek, following the present trail to the Lucky Boy group, and thence to the Tonkin group, which is its objective. Work is to be continued at the Lucky Boy group during the winter.

DOME MILL, AT PORCUPINE, ONTARIO

TRAIL.—During the week ended November 21, 10,664 tons of ore and concentrate was received at the smelter. The Consolidated M. & S. Co. mines provided 9733 tons, and the other shippers were: Bluebell, Riondel, 179 tons; Bunyan, Lake Windermere, 39; Canada Copper Corporation, Allenby, 107; Emerald, Salmo, 33; Helldiver, Lake Windermere, 36; Horn Silver, Similkameen, 93; Josie, Rossland, 164; Club Hill, Republic, 54; North Star, Kimberley, 150; Providence, Greenwood, 40; Ptarmagan, Athalmer, 4; Rambler-Cariboo, Rambler, 42; Velvet, Rossland, 23; and Whitewater, Retallack, 30. During the week the first consignment of concentrate was received from the Canada Copper Corporation; Helldiver and Bunyan appeared on the list for the first time. The Bunyan consignment was in the nature of a trial shipment; there is a large quantity of this grade of ore at the mine, and it is said to be questionable whether direct shipment can be made profitably, or whether it will be necessary to concentrate in order to work the mine. The tunnel at the Morning Star mine, near Nelson, has cut the main vein, which is 10 ft. wide and well mineralized with pyrite and chalcopyrite and carries a little gold and silver. The vein has been traced for 500 ft. on the surface.

ALICE ARM.—The Moose Group Mining Co., Ltd., Van-

couver, has done much work in the opening up of its properties and in the construction of a permanent camp. During the summer a trail has been constructed, winter quarters built, and exploration and development pushed forward, the latter being by means of open-cuts and tunnels. There are two veins so far proved, one intersecting the other. The main vein has a width of 20 ft. The upper tunnel is in 40 ft. with the face in ore averaging about 25 oz. silver per ton. By extending the tunnel 80 ft. farther the two veins will be opened at the point of intersection. On November 1 the lower tunnel was in 21 ft. and the vein now is being cross-cut, with a showing of from 8 to 10 ft. on ore on the downward extension of the orebody. The veins occur in the so-called andesite breccia characteristic of the upper Kitsault section of Alice Arm. Gray copper ore is found with high silver content, a little galena, and a considerable amount of manganese.

Moyie.—The Society Girl mine is among the shipping mines of the Interior. Lessees have uncovered some very rich ore and intend to continue work all winter. After working a little over three months they have taken out $3000 worth of ore. The news of this development has been received with enthusiasm by people of the district, who have of late been more or less gloomy owing to the common report that the mines of Moyie have 'played out' never again to figure as producers.

Golden.—Much is expected of the Bunyan silver-lead property situated on Bunyan mountain, near Lake Windermere. A crew of from 100 to 150 men is to be employed as soon as weather conditions permit next spring. This property recently was taken over from the owners on lease and bond, after having remained dormant for 19 years. The showings having satisfied the new operators, a 600-ft. tram was installed, connecting the working tunnel and the new ore-bins. Motor-trucks have been imported to transport the ore from the bins to the nearest rail point and an early shipment is to be made to the Trail smelter. Mining continues active in the Windermere district. Australian interests have opened the Isaac mine at Briscoe and the same people have re-opened the Nip-and-Tuck. From the latter a considerable tonnage of high-grade ore has been packed down for shipment. It is expected to return about $150 per ton. The Paradise mine still is producing. It is the most consistent producer of the district.

ONTARIO

EMPLOYEE'S SICK BENEFIT FUND AT COBALT

Cobalt.—Co-operation between the mining companies operating in the Cobalt silver area with the members of the Workmen's Central Council has resulted in a scheme to establish an Employees' Sick Benefit Fund. A charter has been applied for and the Fund will be placed in operation as quickly as possible. Workmen are to pay 75c. monthly, this amount being deducted from their pay. Companies are to pay an amount equal to the total contributed by the employees. The benefits consist of $2.75 daily for not more than 13 weeks, with half that amount for a second period of not more than 13 weeks. Upon death, the dependents shall be paid $250. Complete returns of a vote of the workmen show a majority of 84% in favor of the scheme.

Operations are to be resumed within a few days on the Beaver Consolidated. Repairs to the mill are almost completed. The supply of hydro-electric power is still below normal, and the outlook is uncertain. Without rain or a general thaw before the arrival of winter, operations as a whole may not exceed half capacity throughout the winter in Cobalt. Rain and a few warm days would quickly release large volumes of water lying in the swamps and small streams. The zone of mineralization at the 385-ft. level of the Chambers-Ferland mine is broadening out as work proceeds. Officials declare the find to be one of the most important in the company's history. Work is still confined to the slate formation, but a winze is to be put down into the underlying conglomerate, which is believed to be the source of the silver mineralization found in the slate.

Porcupine.—Production at the Hollinger Consolidated is being speeded up. To relieve the situation caused by shortage of power several carloads of coal have been received, which will be used to operate the air-compressing plant. The staff is being steadily increased and a larger tonnage of ore treated, some days reaching as high as 1900 tons. The Dome Mines is also preparing to use its auxiliary steam-plant.

The McIntyre has done considerable drifting on the new vein recently found on the 1375-ft. level with encouraging results, the gold content maintaining a good average though unevenly distributed. One section, 60 ft. long, gives high assays, the vein being much leaner in other places. The vein will be known as No. 7. Drifting is also being done on No. 5 vein at the 1375-ft. level, and the 1500-ft. level is being opened showing gold content that confirms the results of diamond-drill exploration. The dividend of 5% declared by the McIntyre payable January 1 brings the total returns to shareholders up to $2,166,169, being 60% on the capitalization.

The Schumacher is planning to resume operations in the early spring, providing the necessary funds by the sale of 100,000 treasury shares. Development has been carried to the depth of 700 ft. with considerable ore blocked out and the property is equipped with a 200-ton mill.

Kirkland Lake.—The Lake Shore during October treated 1570 tons of ore with a production of $47,077, an average of $29.98 per ton. This is a new high record. Since the beginning of production in March 1918 the Lake Shore has maintained an average of about $25 per ton for a total output to the end of October of $1,098,808, which is the highest average recovery ever made by a steadily producing Canadian gold mine.

Development work on the property of the Thackery Gold Mines, which includes 250 acres in Lebel township, has been discontinued owing to labor shortage. The results so far have been of an encouraging character and more work is planned for the spring.

THE MINING SUMMARY

ARIZONA

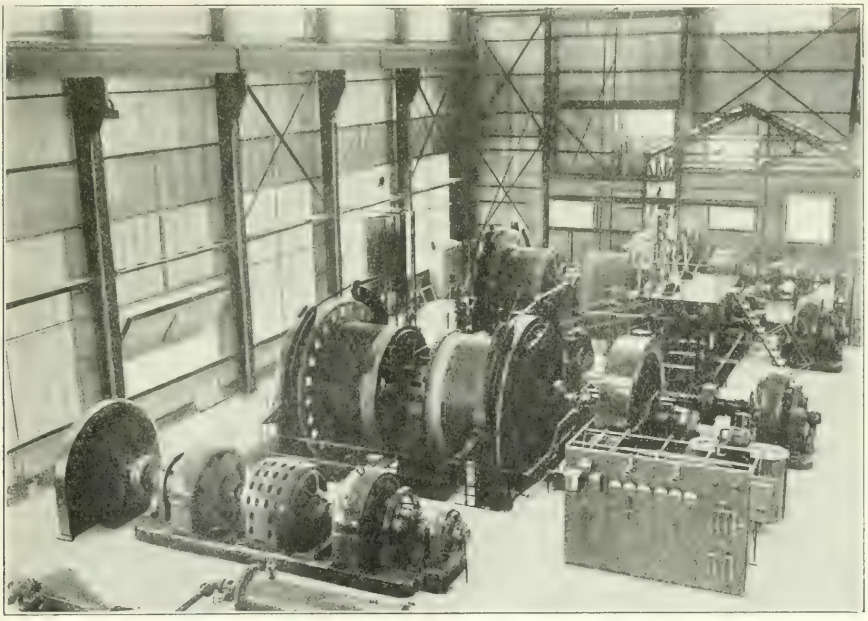
Ajo.—The copper production of the New Cornelia Copper Co. will be kept below 2,500,000 lb. per month until conditions in the copper market improve. This is a reduction of approximately 25% and is accompanied by a corresponding reduction in the force. A find of rich sulphide ore in the bottom of a 36-ft. shaft immediately south-east of Ajo, and not far from the New Cornelia property, is reported. The property in question was at one time known as the Ajo-Cornelia. There are said to be several stringers of ore in the bottom of the shaft, specimens of which have assayed as high as 45% copper.

Globe.—Curtailment of forces is taking place here as in the other districts throughout Arizona. The Old Dominion company has found it necessary to lay off approximately 200 men, as well as a number of shift-bosses, while the three shifts still employed at the Inspiration Copper Co have been reduced by a total of approximately 100 men. No material reductions are reported in the forces at the mills and smelters.

Superior.—A general program of improvement and expansion is planned by the Magma Copper Co. It is reported on good authority that plans covering the widening of the narrow-gauge railroad line, and the erection of a smelting plant, are under consideration. On account of the recent decrease in the demand for copper all construction work will be deferred until a little later.

CALIFORNIA

Calaveras County.—At the Victor gravel mine, formerly called the Rainier, situated near Angels Camp, the work of unwatering is proceeding. The big tank-skips are kept running incessantly and the water in the shaft is lowering much faster than was first anticipated. It is the opinion of the management that it will take constant hoisting for at least three weeks more to free the mine of the accumulated water.



ELECTRIC HOISTS AT THE INSPIRATION MINE

Development of new territory from the recently deepened shaft of the Morgan mine is proceeding with good results. In the new levels the veins are said to be showing the same high-grade quartz as in the upper workings, with all indications favoring persistence of the orebodies to greater depth. The Morgan is one of the premier gold yielders of California and is controlled by W. J. Loring of San Francisco.

Shasta County.—The Globe and Chloride-Bailey mines, near Dedrick, have been sold to J. N. Kilner of New York and Charles Farmer of Hayfork by the Bulkeley Wells interests. Wells retains ownership of the large cyanide plant and plans to dismantle and ship it to his properties near

Gold Hill, Nevada. The Globe is equipped with a large mill and for several years ranked among the foremost gold producers of Trinity county. New orebodies were recently uncovered in the lower tunnel and a considerable tonnage of profitable ore is reported in sight. The new owners plan to operate the two groups and will probably continue development throughout the winter months.

IDAHO

Coeur d'Alene.—The International Mining & Metal Corporation has put miners to work at the Inland property where 600 ft. of development work has been done. The lower working, a 300-ft. adit 250 ft. below the outcrop and an 11-ft. winze, exposed an 8-ft. vein of zinc-lead-silver ore. Assay of ore from the lowest workings gave 27% zinc, 24% lead, and 9 oz. silver. The high-grade lead-silver went 60% lead and 25 oz. in silver.——Men have been put to work on the Silverado mine, near Osborn. The company has a mill, including flotation, and expects to commence production soon. The vein has been drifted on, exposing a good orebody one to four feet wide.

The tunnel of the Pine Creek Mining & Milling Co. is in 250 ft. The tunnel is following the foot-wall, the vein in the face of the tunnel being eight feet wide. The quartzite is freely impregnated with galena and there is a small streak of lead-silver ore carrying little zinc.

Leona.—After years of preparation and construction water has been turned into the canal to supply the giants of the Idaho Gold & Ruby Co.'s placer enterprise. No mining enterprise in the north-west has elicited more favorable and unfavorable opinions than Idaho Gold & Ruby. Those who have confidence in the project, believe it will be the producer of millions.

NEVADA

Arrowhead.—The Arrowhead company has erected a 36-ft. steel head-frame and a 25-hp. gasoline-engine for continuing sinking of the shaft, which is now 325 ft. deep. It will be continued to 350 ft., or 183 ft. below the 167-ft. level, the deepest on which lateral work has been done. When 350 ft. is reached drifts will be driven at this depth.

Divide.—The hanging-wall drift on the 800-ft. level of the Tonopah Divide is in ore assaying $100 and more for the width of the drift, according to an official statement. The drift on the 1000-ft. level is in low-grade ore.

Manhattan.—The west orebody of the 300-ft. level of the White Caps has been entered on the 500-ft. level. The ore is free-milling, as on the upper level, and the value is $20 to $25 per ton. This orebody is distinct from that in the eastern part of the mine, which has a heavy sulphur and arsenic content.

Virginia City.—The Gold Hill labor trouble has been settled as a result of conferences between Governor Boyle, Bulkeley Wells, president of the United Comstock, and the Gold Hill miners' union. Miners are to receive $5.50 until May 31, 1921, and $5 from then until November 30, 1921. Top-men will be paid $5 and $4.25 in the same periods, as will laborers in the mill, and after November 30, 1921, the wage for them is to be $4. The Virginia City mine operators will pay this new Gold Hill scale when their present agreement with the miners ends on January 1, 1921.

Regis Chauvenet, president emeritus of the Colorado School of Mines, died at Denver on December 6, at the age of 78. Born in Philadelphia, he graduated from Washington University, St. Louis, and obtained a post-graduate degree at Harvard. He started his career as a chemist at St. Louis; in 1883 he became professor of chemistry and president of the Colorado School of Mines, retaining this appointment for nine years, during which time he contributed largely toward the growth and improvement of the School.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

R. K. Neill has returned to Spokane from New York.

Dwight E. Woodbridge, of Duluth, is at Portland, Oregon.

Charles Butters has returned from New York to Oakland.

Lloyd C. White has returned from a month spent at Kellogg, Idaho.

Solon Spiro, president of the Silver King Con. M. Co. of Utah, is in New York.

George E. Hyde has been appointed vulcanologist to the Mexican Geological Survey.

Oscar Lachmund has returned to Spokane from China, after an absence of six months.

J. D. Shilling, general superintendent of the Utah Copper mine at Bingham, is in Florida.

Walter E. Gaby has been appointed geologist for the Santa Gertrudis company, at Pachuca, Mexico.

M. G. F. Sohnlein is visiting Western mining camps, on his way to Chile after an extended trip to Europe.

N. J. Martin, mining engineer associated with the New Idria Quicksilver Mining Co., was in Utah recently.

Stanly A. Easton, manager for the Bunker Hill & Sullivan company, has returned to Kellogg from Washington.

A. J. Taylor, of the Dolly Varden Mining Co., Vancouver, passed through San Francisco on his way to Los Angeles.

J. Parke Channing, vice-president of the Miami Copper Co., has been elected president of the Seneca Copper Co. of Michigan.

L. W. Kemp has been appointed general superintendent of the reduction works of the Chile Copper Co., at Chuquicamata.

Glenn D. Cook, general manager, and **F. M. Cook,** treasurer for the Pershing County Mines Co., are in San Francisco from Oreana, Nevada.

C. W. Botsford has been spending two weeks at Magdalena, New Mexico, making geological examination of properties owned by S. S. Lang.

J. L. Oldright, superintendent of the leaching division of the Chile Copper Co.'s plant at Chuquicamata, is visiting metallurgical plants in Utah.

Robeson T. White, for several years general manager for the Braden Copper Co. at Rancagua, Chile, is spending his vacation in southern California.

J. M. Callow, president of the General Engineering Co., spent the month of November at his New York office, and has now returned to Salt Lake City.

C. W. Whitley, vice-president of the A. S. & R. Co., is making a trip of inspection to the Western properties of the company. He is now at Salt Lake City.

Hiram W. Clark, consulting engineer for the U. S. Bureau of Mines at the University of Utah, has accepted the position of deputy smoke inspector of Salt Lake City.

Mototaro Ogino, vice-president of the Furukawa interests in Japan, sailed from San Francisco on December 3 for Yokohama. He spent four months in Europe, Canada, and the United States.

T. H. Jenks is at Denver, having completed the work he has been engaged upon in Colorado all summer. Before returning to Los Angeles he will examine properties in New Mexico and Arizona.

Huston Thompson, of Denver, became chairman of the Federal Trade Commission on December 1 for a term of one year. Mr. Thompson, who was vice-chairman during the past year, succeeds to the chairmanship under the rule of the Commission that provides for rotation in the office of chairman among the several commissioners.

THE METAL MARKET

METAL PRICES

San Francisco, December 7

Aluminum-dust, cents per pound	65
Antimony, cents per pound	7
Copper, electrolytic, cents per pound	14
Lead, pig, cents per pound	5.25—6.25
Platinum, pure, per ounce	$85
Platinum, 10% iridium, per ounce	$125
Quicksilver, per flask of 75 lb.	$55
Spelter, cents per pound	8
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

December 6.—Copper is quiet and steadier. Lead is inactive and lower. Zinc is quiet and stronger.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eights of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Nov. 30	68.12	43.87	Oct. 25	79.92	52.31
Dec. 1	69.75	55.62	Nov. 1	80.31	52.35
" 2	69.62	44.37	" 8	81.90	54.00
" 3	70.00	44.75	" 15	80.02	53.50
" 4	69.00	44.25	" 22	76.41	49.96
" 5 Sunday			" 29	73.72	48.97
" 6	68.00	43.87	Dec. 6	69.08	44.29

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	133.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	90.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	93.66
Apr.	98.35	101.12	119.56	Oct.	101.12	119.10	83.48
May	99.50	107.23	102.69	Nov.	101.12	127.57	77.73
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	Average week ending
Nov. 30	13.50
Dec. 1	13.50
" 2	13.50
" 3	13.50
" 4	13.75
" 5 Sunday	
" 6	14.00
Oct. 25	15.75
Nov. 1	15.08
" 8	15.04
" 15	14.87
" 22	14.62
" 29	14.15
Dec. 6	13.63

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.10	18.75
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	16.53
May	23.50	15.91	19.05	Nov.	26.00	20.45	14.63
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	Average week ending
Nov. 30	5.25
Dec. 1	5.00
" 2	5.00
" 3	5.00
" 4	5.00
" 5 Sunday	
" 6	5.00
Oct. 25	7.08
Nov. 1	6.92
" 8	6.84
" 15	6.61
" 22	6.44
" 29	5.67
Dec. 6	5.24

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.26	5.24	9.22	Sept.	8.05	6.02	8.08
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	7.28
May	6.99	5.04	8.55	Nov.	8.05	6.76	6.37
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85.13	71.50	62.74	July	93.00	70.11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	44.43
Apr.	88.53	72.50	62.17	Oct.	78.82	54.82	40.47
May	100.01	72.50	54.99	Nov.	73.67	54.17	36.97
June	91.00	71.83	48.33	Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	Average week ending
Nov. 30	6.00
Dec. 1	6.00
" 2	6.10
" 3	6.25
" 4	6.25
" 5 Sunday	
" 6	6.25
Oct. 25	7.50
Nov. 1	7.54
" 8	7.31
" 15	6.86
" 22	6.66
" 29	6.25
Dec. 6	6.14

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7.44	9.56	July	8.72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.87	6.53	8.93	Sept.	9.58	7.57	7.84
Apr.	7.04	6.49	8.76	Oct.	9.11	7.82	7.50
May	7.92	6.43	8.07	Nov.	8.75	8.12	6.78
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Date	
Nov. 9	55.00	Nov. 23	55.00
" 16	55.00	" 30	55.00
		Dec. 7	55.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89.00	July	120.00	100.00	88.00
Feb.	118.00	90.00	81.00	Aug.	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102.60	75.00
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	71.00
May	110.00	84.80	87.00	Nov.	120.00	78.00	56.00
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

REPEAL OF EXCESS-PROFITS TAX

Speaking before the Economic Club Jules S. Bache declared the excess-profits tax must be repealed and an adequate practical and honest tax enacted in its place. The latter tax is the gross-sales or turnover tax he says. The other substitute favored by many is the retail-sales tax, which Mr. Bache opposes because of the element of personal judgment that will come into play as to what a retail sale is and probability of a 3% rate in order that the tax may yield as much as a 1½ gross-sales tax.

Mr. Bache expressed belief that the Republican Secretary of the Treasury will "promptly take such measures as will restore prices of Government obligations to prices paid by patriotic citizens.

"It would be a most simple financial scheme that would restore these bonds to vicinity of par, and permit of funding Victory bonds when due, at that price, and, with that done, the largest budget, including service of the debt, that we need contemplate, would be under 3½ billions, instead of the large amount fixed by the Secretary of the Treasury in his report."

"Freeing of capitalists from excessive burdens of taxation," according to Mr. Bache, "would take the advantages out of the municipal-bond investments, and release capital for constructive enterprises to an extent almost incalculable.

"We would not have witnessed the recent debacle in securities markets if large investors were still functioning in our money market. I believe the absurdly low prices of investment securities recently are due almost entirely to surtaxes on income."

He summarized advantages of the sales tax in this way: "It is simple where the present system is distressingly complicated; it will produce ample revenue, whereas taxes now imposed, as profits and incomes decline, must fall far below amounts required; under the sales tax, Government revenue is based on something tangible, namely, expenditures of the people which go on unceasingly and do not vary in hard times or good times to such an extent as seriously to affect revenue; it will stop capital from hiding in tax-exempt securities; it allows the country to save funds for future industrial expansion; it will restore competition, enterprise, and individual initiative, now smothered to death by pursuit of the tax gatherer; it will encourage business thrift, stopping waste of high salaries and extravagances, which can no longer be charged off against taxes; its collection is simple and automatic for both Government and tax-payer; it is fair in distribution, as the one who consumes most and spends most, pays most in taxes.

"It will not increase the price of commodities beyond an average of 2½%, whereas now taxes increase prices nearly 25%; consequently, it will tend to reduce present prices to marked degree; it has been in successful operation in the Philippines for years and has proved in every way satisfactory; it has recently been put into operation in France and is thus far strikingly successful; some forms of it are in operation in Canada, and it is so satisfactory that leading interests there are urging that it be adopted as a complete substitute for all other taxes.

"It is based on sound democratic principles, and by reaching out into new sources of revenue spreads the tax load equitably and in a way most easily borne by all; as it will be passed along to the consumer, millions will pay the tax, but nobody will know or feel it; it enables every taxpayer to know his tax liability."

MONEY AND EXCHANGE

Foreign quotations on December 7 are as follows:

Sterling, dollars	Cable	3 43 7/8
	Demand	3 43 3/4
Francs, cents	Cable	5 89 1/2
	Demand	5 85 1/2
Lire, cents	Demand	3 53
Marks, cents		1 30

Eastern Metal Market

New York, December 1.

The downward tendency continues in all the markets without exception; prices have touched new low levels in all metals on this movement. This is also true in London which has a marked effect here.

Copper has sold in moderate quantities down to 14c. and the market is weak.

Tin has touched still lower levels and there is little animation in the market.

Lead has continued to decline on offerings with no buyers.

Demand for zinc is very small and forced offerings by weak interests have sent down the price.

Antimony is again lower.

IRON AND STEEL

The outstanding feature of the week's developments has been the announcement of a recession to the Steel Corporation's prices on bars, shapes, and plates by two leading independents, followed by practically all of the rest. This also is understood to apply as well to sheets and wire by most of the independents. Just how this will affect companies having fair orders on their books is problematical and is to be decided in individual cases. The net result means keener competition for such new business as develops, both domestic and foreign. The only major product which may be said to remain firm is pipe in which there continues a marked divergence between independent and corporation prices. Nails are down a dollar per keg at Pittsburgh.

The pig-iron market is stagnant and more furnaces are closing down. There is a tendency to limit the piling of stocks and production is falling to around 50% of capacity. It is really a buyer's market.

COPPER

Of paramont interest is the fact that the United States Steel Corporation yesterday, Tuesday, bought 500 tons of electrolytic copper at 13.50c. Further details are lacking. This purchase, taken together with the reported sale last week of 500 tons at 14c., by the American Metal Co. would seem to indicate that the decline in the copper market, which has been in process for some weeks, was somewhere close to the bottom. Offerings by small producers or dealers on a small scale have progressed daily and been a cause of continued weakness. Several of the large producers are not quoting but are willing to consider desirable business at 14c., New York. The London market is also much lower, spot standard yesterday having been quoted at £75 5s. and futures at £75 15s. On November 18 the former was £83 per ton. Buying except in the cases noted is light and confined to small lots by small producers and dealers. Lake copper is nominal at 14c., New York. We quote electrolytic at 13.50c., New York, for December and first quarter.

TIN

The market is dull and without much activity so far as buying is concerned. Prices continue to decline but the unsatisfactory New York market commences to show signs of correction from the fact that large dealers and importers are refusing to sacrifice metal or to sell at less than cost of import. This tendency, if persisted in, is expected to make for a better market. There have as a consequence been only a few sellers all the week unless they could secure import cost at least. There have been some buyers of cheap tin but not much of this has been available. As a result there have been few sellers and not many buyers. The feature has been the low prices in London—lower than in many years. Yesterday spot standard fell to £207 10s., future standard to £212, and spot Straits to £208 per ton. Last week these quotations were respectively £230 15s., £234 15s., and £231 5s. At one time this year spot Straits sold at over £400 per ton. The quotation for spot Straits yesterday was 33.50c., New York, the same as on Monday. Arrivals thus far this month have been 3170 tons with the quantity afloat 3180 tons.

LEAD

New low levels have appeared in this market in common with all others. London prices have been an influence here too. Yesterday spot lead was quoted at £25 with futures at £26 per ton. The former means an import price here of around 5.40c., New York, duty paid. On November 18 this price was £32 per ton in London. The outside market here has fallen to 5.25c., New York, and St. Louis, at which offerings have been made. The leading interest has not yet changed its quotation of 6c., New York and St. Louis, but is expected to lower it any day. In general it may be said that most independent producers are offering lead liberally, but whether this is done because of a desire for orders or in order to realize as high prices as possible during the decline is a matter of argument. One opinion is that neither supposition is right but that the London decline is the main factor.

ZINC

Offerings continue to be made at concessions for the little business going and prices show no tendency to 'firm up'. New low levels have been realized in the week. Prime Western for early delivery has been offered and sold at 5.60c., St. Louis, or about 6c., New York, but the tonnages involved are small. Cash necessities have been the deciding influence in most cases and have been participated in by small interests. Large producers are meeting present prices only when necessary and in limited tonnages and all are curtailing output. It is estimated that the present rate of production of prime Western is about 275,000 tons per month, and that it will decline to about 225,000 tons for the December rate. London has declined decidedly, recently. Yesterday spot zinc was quoted at £29 7s. 6d. with future shipment at £35 2s. 6d. On November 18 the former was £35 2s. 6d.

ANTIMONY

This market is slightly lower. Wholesale lots for early delivery are now quoted at 5.75c., New York, duty paid, with demand light. Jobbing lots are about ¼c. higher.

ALUMINUM

Virgin metal, 98 to 99% pure, is lower in the outside market at 25 to 26c. per pound, for wholesale lots for early delivery. The leading interest's quotation is unchanged at 32.90c., f.o.b. producer's plant.

ORES

Tungsten: The absence of demand continues sharply to characterize the market. Buyers will not consider any offerings. Quotations continue nominal at $4 per unit for Chinese ore and at $5 per unit for Bolivian.

Ferro-tungsten is being offered by Washington, D. C., producers at 59c. per pound of contained tungsten, but the market is quiet.

Molybdenum: The nominal quotation of 60c. per pound of MoS_2 in regular concentrate continues.

Manganese: The market is devoid of demand and quotations are nominal at 45 to 50c. per unit, seaboard, with some sellers asking 50 to 55c. for future positions. Stocks are believed to be heavy.

Manganese-Iron Alloys: There is no interest from consumers and quotations are largely nominal at $150, delivered, for domestic ferro-manganese and $72.50 for 20% spiegeleisen.

T. A. RICKARD, - - - - Editor

ONLY $2,500,000 out of the $8,000,000 appropriated by Congress for the relief of claimants under the War Minerals Relief Act has been awarded by the commission appointed for that purpose. Either the legitimate claims were few or the Commission has failed to perform its proper function.

ASSESSMENT WORK on mining claims is likely to be affected favorably by Congressional legislation now pending. The bill extending the time for such annual work has been reported favorably by the mines committees of both the Senate and House. The Senate bill asks six months relief, the House bill twelve months. Some measure of relief seems assured.

IN our issue of December 4, under 'The Flotation Conference', we quoted the telegram from Mr. Ballot concerning Minerals Separation claims to royalty. The text of the telegram we took from a report of the proceedings, but it was not quite correct. We are informed now that it should have read as follows: "The answer to your question is No, we do not claim payment of royalty for use of first patent in suit or any other patent after its legal expiration. But we do claim payment of royalty for the use of any other of our unexpired patents."

PRODUCTION of gold on the Rand for the current year will be about 250,000 ounces less than in 1919, but the money received for it will be nearly $40,000,000 more, owing to the so-called premium on gold. Up to the end of October the normal value of the output, at 85 shillings per ounce, was £29,272,604, whereas the declared value was £37,281,979. Scarcity of labor has restricted production during the last quarter of the year, the decrease in the supply of Kaffirs being in excess of the customary seasonal variation. In April the total of native laborers on the gold mines was 189,446; at the end of October it was only 159,426.

SPEAKING of Mr. Vanderlip's Russian schemes—not Mr. Frank A. Vanderlip of New York but Mr. Washington D. of California—the 'New York Times' says that he may believe what he says, "but he comes from Los Angeles, a city where long contemplation of the climate has developed the lens of the human eye into a high-power magnifying instrument, and close association with motion-picture press-agents has induced a carelessness in arithmetic". That is 'one on Los Angeles', but we take the opportunity to express admiration for the enterprise of the people in the southern metropolis and congratulate them, among other things, on their freedom from the tyranny of the labor-unions, which has crippled the growth of San Francisco.

A SUM of $170,000 has been asked by the U. S. Bureau of Mines for investigation of the possibilities of obtaining oil from shale. An official bulletin says that "notwithstanding the considerable amount of moneys which have been expended up to the present time, there is not an oil-shale plant producing oil in commercial quantities in the United States". What is needed, we are told, is "essential and fundamental information"; as if Dr. Alderson and his friends had been giving some other kinds of information! We venture to suggest that the Standard Oil Company, and other oil companies, could furnish all the data needed on the subject for the purpose of correcting the misinformation circulated by enthusiasts and wild-cat promoters; but probably they prefer to keep their information in cold storage.

PRODUCERS of silver at Cobalt, who last January were getting $1.37 per ounce for their bullion in New York, wonder if they will wake up and find that the present 60-cent market is only a melancholy dream. There is still a good profit for most of the companies, but a drop to 46¼ cents, the quotation on September 1, 1915, would leave only one or two survivors. Nipissing produced silver during 1919 for 37 cents per ounce, while the Coniagas, Kerr Lake, and O'Brien companies all held their cost below 50 cents. A number of others, however, were unable to do better than 65 cents, and since it is generally conceded that costs have increased slightly since 1919 it is easy to account for the recent passing of dividends and the suspension of operations at some of the properties. The scale of wages paid is the highest in the history of mining in Ontario and there has been little recession in the price of supplies. Economy and efficiency will succeed the effort for high production at any cost that prevailed a year ago. Miners and other employees realize that the only way to maintain their present wages is to do enough work each shift to keep the cost per ounce within a fixed limit. The output per man is said to have been increased 30% without any urging on the part

of managers and superintendents, thereby demonstrating the efficiency that results from voluntary concerted effort. The fact that some of the other companies have released their men has had an important influence on improved production at the mines that continue to operate. Incidentally, the Nipissing company produced 260,865 ounces of bullion during the first week of December.

LAST week our community went through an orgy of crime and newspaper sensationalism, the latter being not unrelated to the former. Three men were arrested for mistreating two young women; when arrested, they shot and killed three members of the police; a few days later they were lynched by a mob. Photographs galore have been published of the criminals, of the girls themselves, whom one would expect to seek retirement, and of the lynching. During the period of these happenings the front pages, and others besides, of our local papers have been devoted to this hideous affair, and the atmosphere of a cheap cinema has prevailed. The Chief of Police threatened to arrest every idler, thereby menacing many politicians. The Mayor ordered the remains of the murdered policemen to lie in state in the City Hall. The one dignified note was that sounded by the Governor in a statement gravely reprobating the lynching. Of course, to try to cure crime by breaking the law is bad citizenship. It cannot be done in that way; it merely disgraces our commonwealth by acknowledging to the world that justice is not promptly or certainly enforcible among us. Much of the crime in our city, as in others, is due to the low character of our police judges, who are elected, and who, by being corruptible, hinder the efforts of the police to bring criminals to account. It is due in part also to the low character of such of the policemen as indulge habitually in graft, that is, the collection of tribute from the vicious element in our city population. A correction of this state of affairs must come through the awakening of public opinion and the introduction of reform in the departments affected, but this cannot be done so long as we are dominated by an irresponsible and meretricious press. The perpetration of crime is stimulated by the notoriety given to criminal acts; moreover, a morbid love of publicity will incite some perverted young men and women to the breaking of the law. The yellow newspaper is assisted by the depiction of criminal acts by the cinema. We note with satisfaction that the legislature of Pennsylvania has passed a law forbidding the exhibition of 'movies' devoted to crimes of violence. It were well if the newspapers could be restrained similarly.

WHEN a carload of ore is sold it becomes necessary, in order to fix the price, to know how much gold, silver, lead, copper, zinc, or other metal it contains. If it were practicable to treat the particular lot separately and reduce and refine the metal content to bullion without mixing with other ores or other products, settlement might be delayed until the process was completed. There are obvious and insurmountable objections to such a procedure even aside from the difficulty that would be experienced in selecting a suitable metallurgical treatment unless the composition of the ore were known definitely. Moreover, the grasping smelter manager would be unable to adjust his penalties with his accustomed cunning. To overcome these difficulties our metallurgical predecessors devised two processes, namely, sampling and analysis. The object of sampling is to obtain a small portion, say, a gramme or an assay-ton, the composition of which, for practical purposes, is identical with that of the entire lot it represents. The object of such analysis is to determine quickly and conveniently how much of a metal or other element resides in the small sample. A simple calculation then determines the quantity of that particular element in the original carload of ore. Sampling and analysis are interdependent; either is useless without the other, and a degree of precision in either in excess of that attained in the other is worthless. It is impossible to weigh, to titrate, and to perform other laboratory manipulation with absolute accuracy, so that there is an allowable limit of error in all such determinations, the degree depending upon the element being determined and the amount of it that is present. The aim, then, is to obtain a sample that is not less accurate, at least, than the subsequent chemical analysis will be. An important consideration in determining the degree of refinement of sampling is the practical factor of cost. Here common sense is the guide. In this issue Mr. H. B. Pulsifer, formerly of the Montana State School of Mines at Butte, and now Professor of Metallurgy in Lehigh University, at South Bethlehem, Pennsylvania, contributes a valuable article on 'Sampling Methods in Montana'. The first part of this article, which deals with the general principles of sampling and suggests directions of possible improvement, will be followed next week by a second, dealing in detail with the methods used at Butte, Anaconda, and East Helena. Professor Pulsifer was given every opportunity to test the different plants, and the results of his work and his observations are carefully recorded. We believe that every seller or purchaser of ore, as well as every operator of a mill or smelter, will find the article well worth careful reading.

NEWS comes to us that Mr. Gelasio Caetani has been elected Mayor of the City of Rome. His many friends in the profession will be keenly interested to hear about this and will join us in cordial congratulations. As on many other good engineers the War had the effect on him of engaging his interest in civic affairs, with a determination to do his part in the work of reconstruction that faced each of the countries lately belligerent. Our readers know that Mr. Caetani played his part finely as a soldier, rising to the rank of Colonel in the Italian army and making himself famous by the affair of the Col di Lana, in which as an officer of engineers he undermined and destroyed a strong Austrian position, killing or capturing all its defenders. In these days when all sorts of miserable tales and sordid relationships are dubbed 'romantic', it is pleasant to recall Mr. Caetani's career as a mining engineer in our West. He graduated

from the Columbia School of Mines when he had barely learned to speak our language, about sixteen years ago. After graduation he worked as a miner, trammer, timberman, and mill-hand at the Stratton's Independence mine in Colorado, at the Treadwell in Alaska, and at the Bunker Hill in Idaho, thereby learning the rudiments of his profession in a thorough manner. He asked no favors but 'went through the mill' with a keen determination to prove himself a capable technician and render himself fit for positions of responsibility. Only his personal friends knew that he was Don Gelasio Caetani, the son of the Duke of Sermoneta and a scion of a historic Italian house of great wealth and influence ever since A.D. 981. By his antecedents, as by his personal charm, he reminds us of Anthony Hope's Prince of Ruritania, and also of one of Marion Crawford's most attractive characters. Indeed, in 'Saracinesca' several members of the Caetani family are supposed to be portrayed. Be that as it may, our mining engineer is no fiction, but a virile personality, who promised to be one of the leaders of the American mining profession until the War and its after-effects diverted his energies to new activities in his own country. Mr. Caetani, to give him his American title, designed the newest of the big mills of the Bunker Hill & Sullivan company; he won recognition on his own merits as a metallurgist, and demonstrated that a pedigree is no bar to a capacity for doing hard work among hard workers. We feel sure that the qualities of mind and person that distinguished him when among us will aid him in achieving success in the splendid task of directing the municipal administration of the Eternal City.

Impressions of the Mining Congress

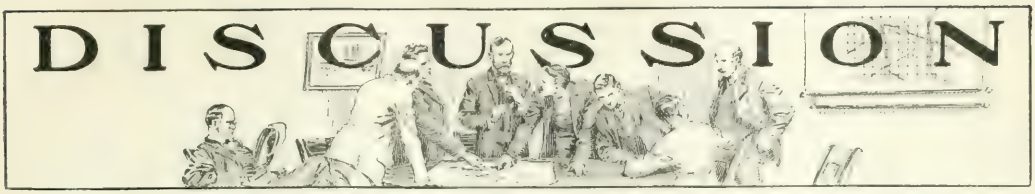
In a recent issue we gave an account of the flotation conference, which was one of the features of the recent convention of the American Mining Congress. Other phases of the meeting are worthy of reminiscent remark. The sessions unfortunately were held in a Baptist church and at first, particularly at the opening ceremonies, the ecclesiastical environment exercised an unduly sobering effect, checking applause and chilling humor, but the gentlemen of the convention soon threw off this unwonted restraint and enlivened the proceedings in a normal manner. The discussion on the deplorable state of gold mining assumed a pessimistic character, thereby evoking support of the McFadden bill. Mr. H. N. Lawrie, economist to the Congress, read an excellent resumé of the argument therefor, and sundry mining engineers portrayed the adverse conditions under which gold mining is being conducted today, in order to prove the need for relief, but when a paper was read on 'Oregon and the Gold Problem' it became evident that a sense of economic perspective is needed in this matter as in others that have world-wide implications. Oregon produced $1,071,000 worth of gold in 1919. Mr. E. P. Mathewson took the chair, after having confessed that he had been converted since last year, the change of conviction in favor of the McFadden bill having been brought about by his observation of the effectiveness of the Pittman Act. As to that favorable legislation, the less said the better just now. Governor Boyle of Nevada, the chief protagonist for the Western movement in favor of a bounty on new gold, did not seem as confident as of yore, for instance, last March at Seattle. He appeared to show the effects of his recent contact with bankers and economists at Washington, and, we venture to suggest, has begun to appreciate the misgiving with which thoughtful men view anything in the nature of a double standard. However, the McFadden bill was duly endorsed, although another resolution advocating the increased circulation of gold by means of a bank to be run in behalf of the gold miners was shelved. The 'open shop' has received vigorous support from the Mining Congress and it formed the subject of a special session, at which Mr. Arthur Notman described the conditions of labor employment at Bisbee and Mr. Charles A. Chase the operation of the open shop in Colorado, these two papers being followed by an excellent speech on labor conditions in Denver by Mr. L. Ward Bannister, who insisted that the unions must be made amenable to judicial process. Such discussions are interesting, but one cannot but feel their unreality in the absence of any representative of labor; how much more useful they would be if they took the form of a friendly debate! Too many statements pass unchallenged when only one phase of a controversial problem is presented. There were other conferences on the tariff, standardization, taxation, and education, but we were not present at these. As usual, several persons on the program failed to appear, it being a common practice on the part of the promoters of these conventions to announce addresses from prominent individuals for the sake, naturally, of exciting public attention; nevertheless the attendance was large and representative, the various Government bureaus sending officials competent to speak for them. Among these were many men well known and much liked by the mining fraternity. Several mining schools were represented at the conference on education. The editors of the two leading mining papers attended, and took part in the discussions.

The annual meeting was sparsely attended, for, truth to tell, these conventions attract many who are not members, and, after all, the total membership of the Mining Congress is small, only 2500. The Secretary, Mr. J. F. Callbreath, read his annual report; indeed he is the man behind the gun; an institution is usually the lengthened shadow of some one man, and to Mr. Callbreath's initiative, persistence, and singleness of purpose the Mining Congress owes its continued existence and its present character. He deprecates the use of the word 'lobby', but, as we have said before, using that word in no sinister sense, the Mining Congress is a valuable lobby established at Washington in the interest of those engaged in the mining industry. That is one function it performs; another is to serve by its conventions as a parliament of mining men, affording an opportunity for the ventilation of current ideas and the discussion of fundamental problems. It ought to have a larger mem-

bership, for if it is to be supported financially not by its members but by the doles of a relatively few large mining companies it will become the spokesman of only a small part of the industry. That is its danger, as we see it. Personally we find its meetings interesting because the politics of mining and the humanistic phases of the industry are more absorbing mentally than the technology of the mine and mill. There is need for such conventions and we hope that the Mining Congress will develop its activities to ever-increasing usefulness. The usual banquet marked the close of the meeting. Mr. Thomas B. Stearns, a mining engineer by education and a citizen whom the people of Denver evidently hold in the highest regard, was an agreeable and efficient toastmaster. The outgoing president, Mr. Bulkeley Wells, received an ovation; the incoming president, Mr. W. J. Loring, was accepted with enthusiasm. The chief speech of the banquet was delivered by Senator Charles S. Thomas, whose sardonic humor was brought to bear upon the 18th Amendment, and the disregard of it; for this evidence was not lacking, much to the satisfaction apparently of many of those present, who probably would agree with us that the air of Colorado is dry, but stimulating. In any event, Denver is a first-rate place for a convention, for is not the climate invigorating, are not the people hospitable, and is not the golf-course a good test of the game? We seem to hear many voices in support of the motion; it is so ordered.

The Impending Labor Crisis

Notice has been given of a reduction of $1 per shift in wages paid at the copper mines of Arizona, this reduction to go into effect on January 1. Similar steps have been taken in other mining districts. It was inevitable. Wages were advanced when the price of copper was high and the cost of living was advancing by leaps and bounds; wages must come down when the price of copper is low and the prices of staple commodities are tumbling. The question is whether this unpleasant readjustment and others of the same character will be made fairly and in an orderly manner. The 'New Republic' anticipates a concerted attack on labor-unionism under cover of a crusade for the 'open shop'. Union labor undoubtedly is on the defensive, as a short time ago it was on the aggressive. Unfortunately organized labor is grasping and greedy when it gets the chance, and unfortunately organized capital is equally so when it gets the chance. The fair-minded and conservative elements on both sides are in a minority. The 'New Republic' says that the trade-union is "capable of control by popular referendum of its personnel". It might be capable of it if all the members voted, but, as a matter of fact, the unions, like the groups of corporations, are led and controlled by a small number of extremists. What the mass of workers want is not the 'closed shop', but steady employment at a reasonable wage. The uncertainty of employment is the curse of the workingman, and that uncertainty no union can correct; but it may be corrected by systematic co-operation between the corporations and the unions looking toward the benefit of industry, and of the community, as a whole. Just now the public outside the laboring class will view any recession in wages as inevitable and even desirable, for without it the readjustment to the after-the-War conditions cannot be completed. Moreover, there is a feeling that the laboring class has used the War and the 'high cost of living' as a lever for excessive demands in wages. All of us have been the victims of extortionate charges, made by all sorts of workers, from carpenters to cooks. There has been 'profiteering' at both ends, by the manufacturer and by his workmen, while the rest of us, the public at large, has had to pay extortionate tribute to both. The War and the conditions it created were accountable for only a part of the rise in commodity and labor prices; at least half was factitious and fundamentally dishonest. Mr. Samuel Gompers and his Labor bureau at Washington are said to have made "a sweeping investigation of living costs throughout the United States" and they are now ready to present Congress with "a complete program of anti-profiteering proposals", aimed against "the big corporations". The pot calls the kettle black. The heroes of our back line of defence collected $8, $10, and $12 per diem for three or four hours work, or less, in our dockyards and factories during the days of national stress; they 'profiteered' to the limit, and beyond; the men in the building trades extorted all kinds of fanciful wages; in California domestic servants more than doubled their scale of pay, although the fact of their being given board and lodging protected them from the impact of the high cost of living. Now Mr. Gompers and his friends plan to stop immigration in order that "the reactionary element" may not "re-establish autocracy in industry". They would like to so curtail the supply of labor as to place the employer class at their mercy, and thereby establish their own "autocracy". Well, it is not unnatural that they should seek to protect themselves, even at the expense of the country as a whole, for, whether it be a leader of labor or of capital, it is yet too early to expect from either any reasonable unselfishness, or even social justice. Judge Gary will offset Mr. Gompers. Meanwhile we have a government of the people and for the people, by the representatives of the people. It seems as if our Department of Labor, if it were competent, that is, just and thoroughly informed, could shed light on some of these difficulties, and perhaps even help to straighten them out. Or must we go through another series of lock-outs, strikes, and general turmoil to reach another temporary armistice between capital and labor? What is needed—and we say it again and again—is the enlightenment of the public, not by specious propaganda from both sides, but by an unprejudiced statement of the case, after competent and impartial investigation, so that the full force of the good sense and justice of the nation may be arrayed against the greed of either side and in behalf of an economic peace that shall do justice to all concerned, including that *bellum quid*, the mass of the people outside the vendetta.



The Divining Rod

The Editor:

Sir—Apropos of your editorial on this subject in a recent issue, I am impelled to contribute a reference testifying to the prevailing practice and wide use of the witch-hazel or divining rod in the 'forties and for many years previous. This reference I find in the introductory pages of a school-book on geology published more than half a century ago. Its quaintness of language recommends it to the notice of your readers.

It is recorded that this book was entered according to Act of Congress in the year 1845, Eastern District of Pennsylvania, and published under the title 'Elements of Geology', J. B. Lippincott & Co., Philadelphia, 1856. The author, W. S. W. Ruschenberger, M.D., attached to the U. S. Naval Hospital, New York, in his preface writes:

"A competent knowledge of Geology better enables the architect to select materials for buildings, as well as sites for their erection; the engineer learns from it where he may run a railroad or canal with the greatest facility, and least cost; the miner is guided in the pursuit of mineral wealth, metals or coal, with greater certainty of success when assisted by this noble science, which is more unerring than witch-hazel or divining rod; it facilitates the physician in the study of climate, and opens up a wide field to the divine for pointing out the wonders of creation and the goodness of God."

Denver, November 23. FORBES RICKARD.

The Editor:

Sir—I was somewhat disappointed at your manner of handling the question of divining rods and water-witching in your last issue. Probably, because I am as intolerant of a superstition as a bull of a red flag. There is such widespread belief in this particular ancient hocus-pocus, and so many credulous persons are yearly gulled by means of it, that I think the subject merited more serious and critical treatment at your hands. You may be chagrined hereafter to see parts of your editorial quoted in the prospectuses of charlatans in support of their claims.

The article by William Pryce is interesting to antiquarians, but if you had reprinted Rossiter W. Raymond's historical review of the subject, published in 'Mineral Resources' for 1882, and in Vol. II of the Transactions of the American Institute of Mining Engineers, you would have contributed far more to our knowledge, and, at the same time, would have dealt some smashing blows at a childish and costly superstition. Raymond says in conclusion:

"To this, then, the rod of Moses, of Jacob, of Mercury, of Circe, of Valentin, of Beausoleil, of Vallemont, of Aymar, of Bleton, of Pennet, of Campetti—even of Mr. Latimer—has come at last. In itself it is nothing. Its claim to virtues derived from Deity, from Satan, from affinities and sympathies, from corpuscular effluvia, from electrical currents, from passive perturbatory qualities of organo-electric force are hopelessly collapsed and discarded. A whole library of learned rubbish about it which remains to us furnishes jargon for charlatans, marvelous tales for fools, and amusement for antiquarians; otherwise it is only fit to constitute part of Mr. Caxton's "History of human error". And the sphere of divining rod has shrunk with its authority. In one department after another it has been found useless. Even in the one application left to it with any show of reason it is nothing unless held in skillful hands, and whoever has the skill may dispense with the rod. It belongs, with "the magic pendulum" and "planchette", among the toys of children. Or, if it be worthy the attention of scientific students, it is the students of psychology and biology, not of geology and hydroscopy and the science of ore deposits, who can profitably consider it."

The U. S. Geological Survey, in 1917, published a pamphlet entitled 'The Divining Rod', reviewing its history, and concluding, "It is difficult to see how for practical purposes the entire matter could be more thoroughly discredited."

GRANT H. SMITH.

San Francisco, November 20.

The Editor:

Sir—Several years ago a cattle-man living near Mariposa, California, at an elevation of about 600 ft., was puzzled as to how he could find water. He made the fact known to those in his employ. One of the men said, "I can locate water for you and will be glad to do so." The cattle-man said to him, "This is your opportunity to make $50, providing you find sufficient water for domestic purposes." The man proceeded to look for water at once after cutting a forked branch from a sapling oak. Passing a certain point near the house the divining rod bent downward, crossing this point the rod rose to a vertical position, and then bent downward again over the man's back. Being satisfied that he had located the right spot, he took a straight branch about 2 ft. long and holding it over the spot he had marked, the branch bent up

and down 26 times indicating the depth at which water should be found. The well was dug; at a depth of 32 ft., a flow of water came into the well, rising to a depth of 5 ft. The water was fine and there was an abundance of it.

The gentleman who called at your office to ascertain where he could buy a divining rod to use in finding some gold buried near Vallejo probably is under the impression that the gold Winters stole from the Selby smelter several years ago was not entirely recovered and still lies buried near Vallejo. If this is his opinion, I can assure him that every ounce of gold bullion and four bars of refined gold were entirely recovered. I was assistant to the head refiner at the time of the robbery.

Two days after the robbery three divining-rod men appeared upon the scene at Selby and operated with their rods for several days between the Selby plant and Vallejo Junction. They stood upon the bank within 30 ft. of where Winters threw the gold into the bay. Although there was $25,000 reward offered by the Selby company for the recovery of the gold, not one of these divining-rod men was fortunate enough to lay claim to any of the reward. There was $283,000 in gold bullion and refined gold lying within 30 ft. of them under about 15 ft. of water. They disappeared as mysteriously as they appeared. The gold was not recovered until Winters confessed to the authorities and pointed out to them the exact spot where he threw the gold into the bay. Three detectives (who accompanied Winters, along with others) immediately stripped and recovered most of the gold by diving, in three hours. Three days later the detectives had recovered all the gold except the four bars of refined gold and a small bar of gold bullion weighing 18 oz. These were recovered by a professional diver.

W. A. Middleton.

Martinez, California, November 21.

An International Association of Silver Producers

The Editor:

Sir—The severe fluctuation in the price of silver, in the open market, during the last year, is the very strongest argument to the governments of the world that silver is no longer a suitable metal to be used as money. Some of these governments will not look favorably upon the loss in value of their reserves, due to an abnormal drop in the price of silver. Others will lose confidence if they have to be repeatedly switching currency laws to follow an unstable market. Those individuals accustomed to hoard it will also lose confidence in its pre-eminence as an article of permament value. In fewer words, a fluctuating price for silver means a continued reduction of demand, and consequently a serious and permanent factor in the reduction of average silver prices.

The great bulk of silver mining is done by fairly large companies who put their product on the market with little regard to the prices obtained. As far as possible, they work their mines at an even grade and tonnage of ore, the principal exceptions being those mining silver as an auxiliary to copper. The policy of steady production may be logical from the point of view of economy in mining and treatment, but it fails to take into account the peculiar position of silver among the metals.

All silver passes through a refinery, but the refiner simply acts as middleman and has little concern about the market. When fluctuations become violent he protects himself by liquidating with the producer on the basis of the price at the date of sale of refined product. The buyers of silver are mainly the governments, for the middlemen do not speculate to any extent, and it is desirable that speculators should stay out of the market.

The burden of the proper regulation of market prices therefore rests between the governments and the producers. The governments can hardly be expected to buy steadily, because the demand is not steady; for example, it fluctuates with the conditions of crops and trade in the Oriental countries. Steady buying on the part of the governments of these countries would entail the storage of large amounts of silver over a considerable time, and such investment would draw no interest.

The producers, acting in concert, would be in a much better position to regulate prices, because they would be able to leave silver stored in the ground. In doing so, their investment in plant would not necessarily be lying idle, because with a reasonable market price for their product they could be mining and milling low-grade ores, and their expenses could be correspondingly cut, by a reduction of development and improvement.

If such an association as is here advocated were firmly established, and so properly and reputably maintained as to gain the confidence of the governments concerned, these would no doubt be willing to enter into contracts for the delivery of silver over a term of months at an agreed price, participation being distributed among the members of the association willing and able to comply with the terms of the contract. This would secure for the producers a security of market over that period, so that improvement in the mine and plant could be undertaken with entire assurance.

Blamey Stevens.

Triunfo, Lower California, Mexico, November 20.

Mr. Hoover's Biography

The Editor:

Sir—Perhaps it may be permitted to other actors in the field to enter this amiable little discussion regarding Mr. Hoover and early days on the goldfields of Western Australia.

My own entry into Coolgardie was in January 1895, in the employ of Bewick, Moreing & Co., and I well remember (owing to the ravages of enteric fever) being the sole representative of Bewick, Moreing & Co., and of Alexander Mathieson, an allied mercantile company, and having our office in a contractor's hut in the middle of Bayley street.

The first permanent office was at the Coolgardie Chambers, 1895, and afterward extensive private offices of our

own in 1896. From 1894 to 1898—when I left—Coolgardie was the central office of Bewick, Moreing & Co. in Western Australia. As Mr. Wilson states, outside Hannan's Brownhill mine, the firm had no office at Kalgoorlie.

Now, as to single-jacking. At Kalgoorlie I was familiar with every hole in the ground, and the practice at every mine, yet I never remember seeing anything but double-hand drilling. On the other hand, I remember when Mr. Hoover came to Kalgoorlie, in 1897, showing him around the mines there, and when he went almost immediately to Lawlers, hearing of his introduction of single-hand drilling, from which a considerable economy was claimed. The 'Barrier', or Broken Hill, supplied almost all the men who became the operators on the Goldfields, and practice there followed the 'Barrier'. Now, if single-jacking was prevalent at the 'Barrier', then it would doubtless have been followed in Western Australia.

Be that as it may, never in my experience did I see, at Menzies, Coolgardie, or Kalgoorlie, anything but double-hand drilling.

Now, as to Cornishmen teaching the world single-jacking. I have worked underground in Cornwall at Dolcoath, and spent my early days amid the mines there, but I never remember seeing an instance of single-hand drilling. The miners always worked in pairs. The hard tin 'capel' of the district necessitated a heavy 'mallet', with one man 'beating the boyer', and the other 'turning'. In my student days underground in Cornwall, I should much have appreciated the gentle art of single-jacking, and so have escaped the penalized inaccuracies of my fellow-students. In Dolcoath's wide stopes it was not an uncommon sight to see three or four lusty men swinging sledges the full 'St. Andrew's swing', and beating a drill with rythmic and accurate precision.

So, whatever Cornishmen have taught the world in mining, the practice of single-jacking would not seem to have emanated from the Camborne district.

Santa Barbara, November 18. H. E. West.

[Has Mr. West ever heard of St. Just?—Editor.]

Emerald mining is a Government monopoly in Colombia. The best-known mines—the Muzo and Cosquez—are situated in Boyaca about 90 miles north-west of Bogota; a third, the Somondoco mine, is about 35 miles east of Bogota; and a fourth deposit, the Cuincha, across the Minero river from the Muzo mines. The two last named deposits are said to be as rich as the more famous mines of Muzo and Cosquez, but are not easily accessible. The Muzo deposits lie in a valley on a spur of the eastern Cordillera, two or three days' journey on muleback from Bogota over bad trails through rough country. The emeralds occur in veins of calcite traversing black Carboniferous limestone. To follow the veins steel bars and shovels are used to cut down banks, great care being exercised not to injure the emeralds as the veins are approached. No engineering skill can determine beforehand the approximate value of any vein or deposit, but wherever a vein shows it is followed, even for years, and once a productive formation is found it is worked night and day until exhausted, sometimes over a period of years, as at Muzo.

San Francisco Mint Adopts Electric Furnace for Melting Copper and Nickel

The U. S. Mint placed in operation on November 9 a ½-ton Rennerfelt electric furnace. This furnace supersedes several gas-heated crucible-furnaces, and is being employed for melting cupro-nickel and bronze mixtures used, respectively, for the five-cent and one-cent coins. The furnace is not being used for melting gold or silver.

The furnace operates on two-phase, 60-cycle current, supplied at 2200 volts by the power company, and stepped down to approximately 110 volts at the furnace. The amperage during a heat ranges between 650 and 800. There are three carbon electrodes. The holders are water-cooled and the arc is regulated by hand. It is probable, however, that this will be superseded by automatic regulation. The furnace has an acid lining and bottom, silica brick and sand being used. It is charged with pigs of copper, nickel, etc., together with crop-ends from the ingots, punchings from the sheets of metal from which the blanks for coins are cut, and other scrap from the coinage operations. On account of the method of operation, however, this scrap is practically as free from impurities as the original metal. No flux is used, but a layer of charcoal is shaken on the surface of the metal in the pouring-ladle to protect it from oxidation.

At the present time the metal is poured into a hand-ladle holding about 100 lb. of metal, and from the ladle into the ingot-molds, which are of steel and are arranged in a sort of circular rack. The molds are made in two halves, which are clamped together. The inside of the mold is swabbed with crude oil to prevent the molten metal from adhering to it. Each ingot is approximately ¾ by 3 by 24 in. and weighs about 10 lb. A few minutes after pouring, the ingots are cool enough to permit opening the molds. The ingots are removed and quenched in water, the interior of the molds is swabbed again with oil, and the molds are re-clamped ready for pouring again. After cooling, the ingots pass to the cropping machine where the upper part of the ingot is sheared off. The ingots then go to the rolling-room. This procedure is soon to be modified by the installation of a slow-moving conveyor upon which the ingot-molds will travel. Operations will be timed so that, at the proper interval, the molds will be opened, the ingots quenched, and the molds returned to the pouring-position. A conveyor will also take the ingots from the quenching-tank to the cropping machine. In the rolling-room the ingots are rolled into sheets the thickness of the coins, 22 passes through various-sized rolls being required. The coin-blanks are then punched from these sheets, after which the blanks pass through a machine that turns up the edge. They are then annealed and polished before the final operation of stamping.

Methods of Ore-Sampling in Montana—I

By H. B. Pulsifer

Introduction. The mechanical sampling of ores has reached a stage of great practical utility, yet, like all other industrial practices, it is subject to change with general progress, as well as from the hints arising in the course of daily work. The following notes will serve to describe certain advanced practices and present conditions, and to suggest directions along which improvement appears promising.

Almost any study of sampling may be resolved into a critical consideration of four phases comprising the basic features of the work. These are precision, cost, method, and equipment. Precision and cost have been placed first in the list because they determine the method and equipment to be used.

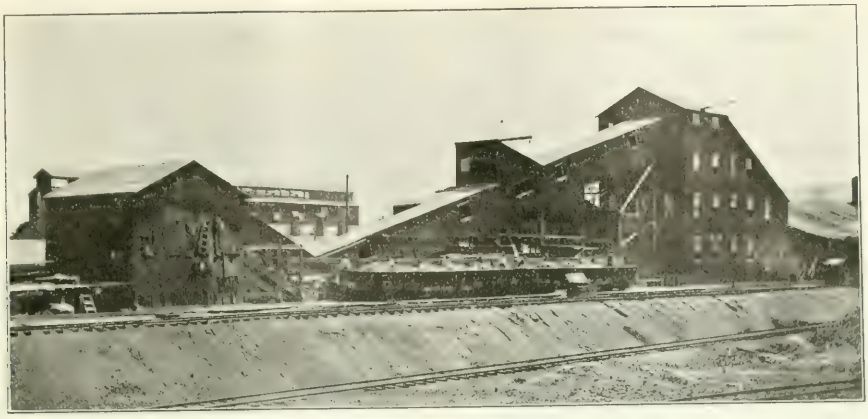
Precision of Sampling. The degree of precision that is needed or desirable in any one sampling operation depends greatly on the material to be treated and the purpose in view. A combination of good grab-samplings in the mine, at the hoist, and at the furnaces will sometimes suffice if all the operations are under one management and the chemical control is not rigid. This sort of grab-sampling frequently meets the requirements for iron ores, limestone, and coal; it may cost only a fraction of a cent per ton or, at the most, only a very few cents per ton. At the other extreme are the samplings of gold, silver, lead, and zinc ores, which are mined, sold, and treated under the most rigid chemical control and which can well stand a sampling-cost of over a dollar per ton. In the first and most lax type of sampling any one result may not represent the lot to a greater precision than one part in twenty or thirty, yet, because of repetitions and numerous averagings a satisfactory working figure is finally obtained. In contrast with grab-sampling, the more elaborate sampling of the rich metal ores may demand a precision of one part in a hundred at one single operation. There is, of course, much sampling of intermediate precision requiring results to about one part in forty or fifty.

The matter of precision in sampling may be a balancing of sampling effort against uniformity of material; at one extreme comes practically uniform stock requiring very little equalization to secure a representative sample, at the other extreme are materials like high-grade gold and silver ores, which may well require fine grinding and thousands of cuttings to yield a suitable sample. Nearly all the custom sampling-mills in the West handle the ores to give a sample good to one part in forty or fifty by crushing four-fifths of the lot no finer than to two or three inch size and at a cost of from ten to fifty cents per ton.

Rational sampling work demands recognition of two auxiliary operations that are tied in series with the sampling proper as establishing the money-value of a lot of ore. The two operations are the determination of moisture and the chemical analysis. If the moisture sample is uncertain to one part in fifty or sixty, or if the chemical analysis is uncertain to one part in thirty or forty, or if both are uncertain to about this degree, then it is only a waste of effort to push the sampling precision to greater than about one part in sixty or seventy. It is common to find figures for ore and metal production, extraction, and cost expressed to a refinement of one part in ten thousand, or a million, when neither net weights, samplings, nor analyses are better than one part in seventy-five. Such sequences of figures are impressive only in their absurdity.

A silver-lead ore may be chosen to illustrate the significance of the relationship between the relative precisions in sampling and analysis as affecting the final result. Assume a commercial ore containing about 40% lead and 20 oz. silver per ton. Buyer and seller would like to know the lead and silver contents to within 10c. per ton; neither would care to quibble over an amount smaller than this. It follows that a 10c. fluctuation in the lead means 1.25 pounds, and 10c. difference in the silver means 0.1 oz.; if lead is reckoned at 8c. per pound and silver at $1 per ounce. One and a quarter pounds is about 0.16% on a 40% lead ore, or approximately one part in 630 parts. A tenth-ounce of silver is 0.5% on a 20-oz. ore, or one part in 200 when stated in whole numbers. It is obvious that only extraordinarily good sampling could hope to approach this refinement and it is even more certain that such a degree of precision is entirely outside the range of commercial analyses. Analysts commonly differ by from 0.5% to 0.8% on a lead determination of a 40% ore when using the same homogeneous sample; they may differ by from 0.2 to 0.5 oz. on a 20-oz. silver ore. A silver determination may reasonably be expected to be trustworthy to one part in forty parts and the lead determination to one part in fifty parts; when put into dollars and cents these limits amount to 50c. per ton on the silver and $1.25 per ton on the lead. Buyer and seller would, then, be foolish to expect to agree to within 10c. per ton on silver and lead and might with good reason decide to split any differences not greater than $1.50 per ton on lead and 50c. per ton on silver.

It is here that the ancient bogey of high results by the agents of the seller and low results by the agent of the buyer enters to upset many otherwise good understandings. The trouble will persist until standardized analyses are established. Standardizing of analyses is a difficult matter and is delayed by shortsighted business interests. It is bound to come in due time, however. At present one may affirm that the personal factor is far better eliminated from mechanical sampling than from analytical practice.



No. 1 SAMPLING-MILL AT EAST HELENA

One of the first investigations of the recently established Montana State Bureau of Mines and Metallurgy was a study of the custom ore-sampling plants in Montana. Possibly the most important part of the work as published in Bulletin No. 3 (March 1920) of the Bureau is a test of the precision of sampling as demonstrated by the three most important custom sampling-mills in Montana. These often make repeat samplings on the same lot of ore in the same mill, and once in a while a lot of ore gets sampled in two of the mills, but no lot of ore had ever been sampled in as many mills and as many times as this particular lot. The State Bureau borrowed a 50-ton lot of silver-lead ore containing also commercial amounts of gold and copper. The carload weighed a little over 50 tons and consisted of run-of-mine ore from a mine within the State. The material was not wholly ideal for the test, but it was the most suitable at that time available and was well adapted to demonstrate the degree of precision to be expected from the mills. The lot contained rather too much fine, yet fully a quarter of it was in chunks over two inches in diameter.

The minerals in the test lot consisted mainly of sulphides in a quartz gangue. The texture varied from large pure grains and sulphide lumps to intimate sulphide mixtures and black earthy powder. The composition was estimated from the analyses to be approximately:

	%
Quartz	30
Pyrite	25
Galena	15
Arsenical tetrahedrite	15
Zinc-blende	5
Other gangue-minerals	10

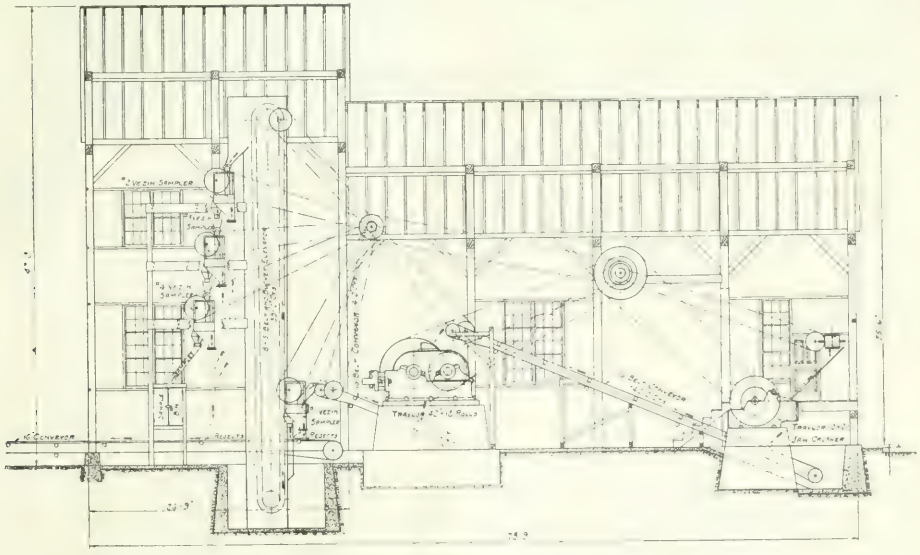


FIG. 1. ELEVATION OF A SAMPLING-MILL DESIGNED BY THE TRAYLOR ENGINEERING CO.

I quote from my article in the Bulletin:

"The lot typified Montana ore of the better sort, with commercial values in gold, silver, copper, and lead; an ore suitable for demonstrating the precision of sampling on customary and average materials.

"The lot of ore was sampled twice at the Washoe sampler, resulting in two independent final pulps. The lot was sampled in the No. 1 mill at East Helena, using the coarse by-pass; it was tenth-shovel sampled at East Helena, and then finally ground to pass the 2-mesh screens and again sampled in the No. 1 mill, this time in the ordinary way. The lot was sampled once at the East Butte mill while in the coarse condition, but duplicate portions were taken from the mill-product before fine grinding.

"Six different samplings were thus made, giving seven pulps; three different types of mechanical cutters were used and once the lot was hand-sampled. The hand-sampling was first by the tenth-shovel method, and it was then coned and quartered until the final splitting for packets was made with a table-riffle.

"The actual sampling time at the different mills varied; at the Washoe sampler the lot required 20 and 30 minutes at each respective sampling; at the East Butte mill 50 minutes was required for the sampling; at East Helena fully two hours was taken each time the lot was run through the mill.

"The final sampling at East Helena, after crushing to half-inch size, afforded a good standard test, since the material was then all in small sizes, had undergone repeated dispersions and retardations in the mills, and was cut at least 3500 times by each of the mill samplers.

"The lot was sampled in the presence of the author in each instance; no particular arrangements were made at the mills, nor was the sampling carried out in any way differently from the routine procedure which the author has repeatedly observed when he has happened into the mills.

"The seven final pulps were analyzed under as nearly identical conditions as possible in the State School of Mines laboratories. Lest too few results might involve deviations in the chemical work instead of in the sampling, the analyses were checked over from six to eight times so as to furnish average figures for each component. Pulp inequalities, chemical influences, and manipulations all introduce deviations, which repeated analyses alone can eliminate so as to show the precision or lack of precision in the sampling.

"The results of the analytical work follow:

Sample	Silver, oz.	Gold, oz.	Lead, %	Copper, %	Iron, %	Insoluble, %
A	37.8	0.21	12.73	1.74	14.49	32.98
B	37.3	0.22	12.46	1.69	14.43	33.07
C	37.0	0.23	12.50	1.74	14.46	32.87
D	37.9	0.21	12.64	1.78	14.77	32.61
E	37.3	0.21	12.64	1.76	14.52	32.83
F	37.4	0.21	12.72	1.70	14.35	32.50
G	37.5	0.22	12.91	1.73	14.72	32.22

"One conclusion, only, can be drawn from the results in the table: namely, that the sampling was well done in each instance. The difference between the several pulps is less than excellent analysts might report on one and the same pulp.

"The individual items and gross values of the lot may be calculated for each sampling, reckoning silver at $1.25 per ounce, gold at $20.67 per ounce, lead at 8 cents per pound, and copper at 18 cents per pound.

Sample	Silver	Gold	Lead	Copper	Total	Deviation from mean
A	$47.25	$4.34	$20.37	$6.26	$78.22	+$0.44
B	46.62	4.55	19.94	6.08	77.20	—0.58
C	46.25	4.75	20.00	6.26	77.26	—0.52
D	47.38	4.34	20.22	6.41	78.35	+0.57
E	46.63	4.34	20.22	6.34	77.52	—0.26
F	46.75	4.34	20.35	6.12	77.56	—0.22
G	46.88	4.55	20.66	6.23	78.32	+0.54

"The total values range from $77.20 to $78.35, an extreme difference of $1.15; the average deviation from the mean of all the totals is $0.45. Ore-producers should certainly be well satisfied with custom sampling which shows this degree of precision."

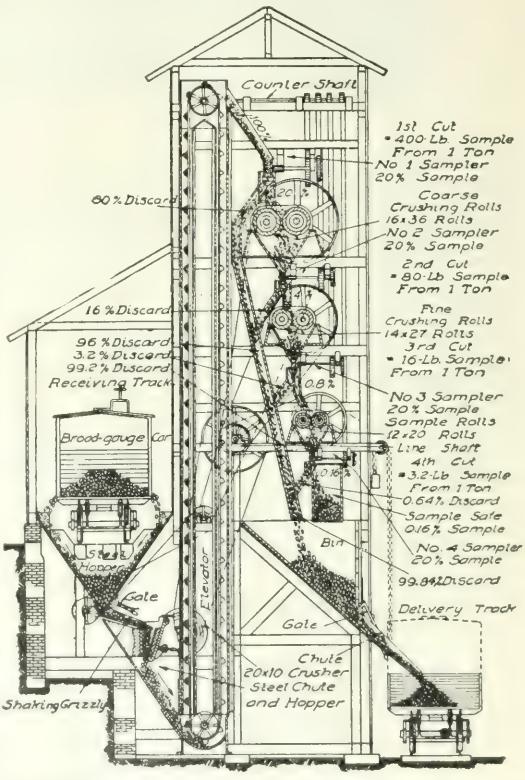


FIG. 2. TAYLOR AND BRUNTON SYSTEM OF SAMPLING AS USED AT THE WASHOE SAMPLER AT BUTTE

Mechanical sampling of the degree of precision indicated will generally be considered excellent work for the sort of material used. The results also bring out an important fact often overlooked, namely, that the degree of precision is a function of the amount of the element determined. In the above table the precision is least on the gold, amounting to one part in 20 on the 0.2 oz. of gold present. If there had been only 0.02 oz. of gold present, the precision might have been no greater than one part

in three. The precision on the silver figures to about one part in forty; the results on the lead, copper, iron, and 'insoluble' are intermediate between those on gold and those on silver.

At Butte, copper ores are considered easy to sample. The copper minerals are fairly well disseminated and, of course, highly brittle. The low grade of the copper ores, from 2% to rarely as high as 10%, is also in favor of both sampling and analysis. Two or three per cent of copper in an ore is low enough to avoid the pitfalls of mechanical sampling and yet large enough for good precision in the chemical results. The chemical determination of copper is, furthermore, one of the most precise commonly made. The experience of the Butte district is that lead, zinc, and silver ores are less easy to sample than copper ores, and that gold ores are the most difficult of all to sample. A Butte copper ore would have afforded a too easy, and thus inconclusive, test of the sampling-mill practice, whereas a gold ore would have been entirely too difficult for a practical test.

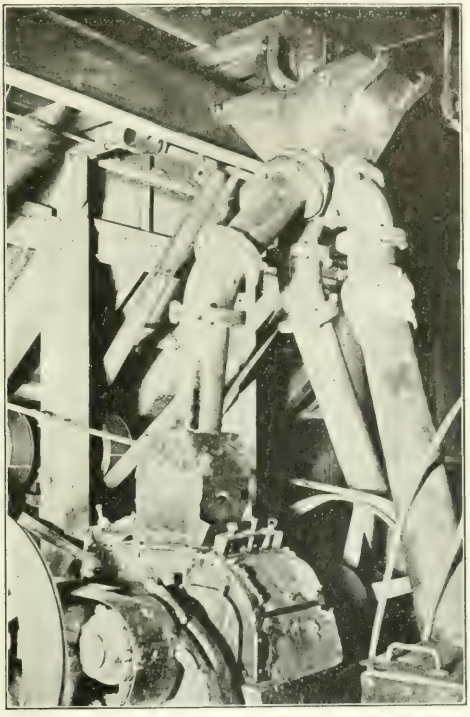


FIG. 3. THIRD CUTTER AND THIRD SET OF ROLLS IN WASHOE SAMPLER AT BUTTE

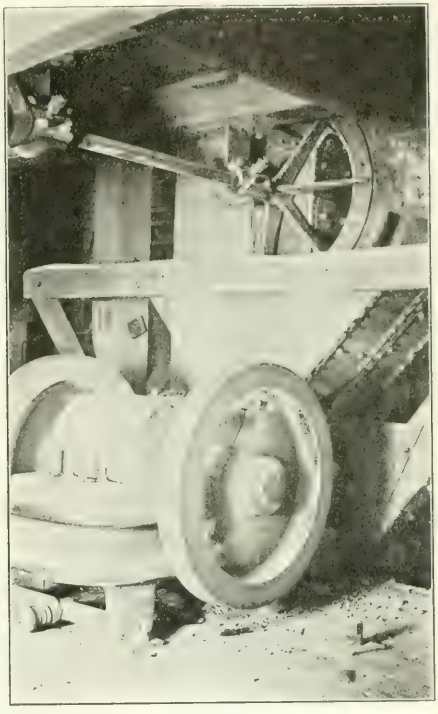


FIG. 4. BRUNTON CUTTER ABOVE CRUSHER AT ANACONDA SAMPLER

COST OF SAMPLING. There are some ores, like iron ores, that are cheap, fairly uniform, and satisfactorily sampled at an outlay of only a fraction of a cent per ton; there are other ores and metallurgical products of such value that an expenditure of a dollar, or more, per ton is not considered excessive. After the degree of precision and approximate cost of sampling are established for any given material, one can select the method and equipment best suited for the work. It would be far from true to say that this logical sequence is commonly followed in practice; numerous and unexpected exceptions occur because of customs, habits, available equipment, workmen trained in certain ways only, or from lack of knowledge of better ways.

In the Western States there are probably fifty sampling-mills built to sample copper, lead, and precious-metal ores; these mills were built to displace the hand-sampling by shovel and cone-and-quarter methods as first used or to accommodate the large-scale operations more recently established. They have a decidedly stereotyped design as forced upon them by conditions now more or less obsolete.

The Western ores that needed sampling have usually been of sufficient value to stand a charge of from 10c. to $1 per ton and justify the construction of permanent and substantial mills. The prevailing blast-furnace smelting of past decades demanded as coarse stock as possible and favored the crush-and-cut method now almost exclusively used in the mills. A further determination of present mill-design came from the former necessity of elevating

stock by bucket-elevators exclusively, and the impracticability of putting more than one crush-and-cut couple on any one floor of a mill. The general result has been that the mills are built very tall, the entire lot is lifted to the very top of the mill, and then loses its elevation by falling from floor to floor, a large part of the fall being wholly lost in simply getting from machine to machine or from floor to floor. Further disadvantage comes from having to distribute power, attendance, and machinery over five or six superimposed floors.

The reasons given may account for the present design of sampling-mills, yet offer no excuse for their not being more efficient, operating at less cost, and being built on more recent patterns. A manufacturer will tell you that there are not enough sampling-mills built to warrant extensive study or the planning of special machinery. He will say that sampling-mills are built only rarely, that the average mill handles only a small tonnage with a scanty treatment, that all the sampling-mills in the country do not amount to as much as one big concentrating plant. There also appears to be something secret about sampling costs and operating data, thus excluding from effectiveness that most stimulating factor in industrial progress, namely, publicity. When a sample-mill has been built and put in service it is then left to wear itself out; they are seldom altered and improved as are concentrating mills. Plans have always called for standard design and standard equipment of the most conservative type.

It is now common for sampling-mills to use belt-conveyors, but largely as adapted to the old idea of numerous superimposed floors. The East Helena plant of the American Smelting & Refining Co. has five floor-levels, although it is a mill elevating solely by conveyors. Why should not the units in a sampling-mill be served by belt-conveyors with all the machinery in line and on one level? The sample-cutters can be placed close under each crushing-unit and deliver the sample to a conveyor elevating to the next rolls. All the rejects can be collected on one and the same conveyor and loaded into cars at the far end of the mill. A mill with the crushing equipment on one floor should be excellent from the construction, mechanical, and power distribution points of view. One crane could serve all the units and greatly facilitate repairs. Supervision and attendance would be greatly facilitated by a one-floor design.

An incomplete fulfilment of the one-floor design is illustrated in Fig. 1, which is supplied by the Traylor Engineering Co., and is an elevation of a mill designed for the Northport Smelting & Refining Co. In comparison with the Northport mill, whose total elevation covers some 54 ft., may be offered the older scheme of the Washoe sampler, whose total height from lowest elevator-pit to point of roof is 96 ft. One might conclude from Fig. 2, which is the sampling scheme of the Washoe sampler, that the machinery is quite closely spaced and that little elevation is lost; Fig. 3, however, shows the actual spacing of two of the units and demonstrates how 75% of the fall on one of the floors is so much lost elevation. Fig. 4 is a picture of one of the oscillating cutters over its crusher in the Anaconda sampler; there is no lost elevation in this instance.

The ungainly large size of sample-cutters theoretically adequate to handle the first selections in a mill has prevented their use. This source of possible criticism can be closed by placing the cutters immediately below the crushing units in the basement where their large size and awkwardness would not be so conspicuous. There are strong reasons for the insertion of storing and equalizing devices between a cutter and its next following crushing unit. Devices of this sort need occupy only little headroom and would fit in with horizontally arranged machinery as well as the present vertical arrangement.

Straight-line single-bay sampling-mill design ought to decrease the original construction cost by from 25 to 40%, as well as decrease all subsequent operating and maintenance costs by an equal amount. Many mills suffer seriously in capacity, and consequently in the cost of sampling, from delay in unloading cars, especially because of ore in solid bottoms or box-cars, from frozen ore, from muddy ore, from mill-chokes and break-downs; with such sources of expense eliminated one looks to design and economy for the next most feasible improvement. The straight-line design is offered as one suggestion worthy of trial.

The cost of sampling is usually considered an unproductive expense to be held at the lowest possible limit. However, in industrial operations, sampling is as necessary as mining, weighing, or extracting a metal. The cost of sampling is fortunately a minor expense, yet, because in the aggregate it amounts to a large sum, it deserves to be studied as any other cost-factor.

If two men working for 75c. per hour can pipe-sample a 50-ton car of concentrate in 30 minutes, the cost obviously is 1.5c. per ton for the uncorrected item. The cost of pipe-sampling will be greater than 1.5c. per ton because of unproductive time, bucking-room charges, and overhead expense; 5c. per ton is probably a closer figure for the actual expense. Pipe-sampling affords good precision and low cost when the material is suitable. The tendency toward greater production of concentrates instead of marketing raw ores unites with the low cost and precision of pipe-sampling to assure it increasing usefulness in the future.

Crush-and-cut methods of sampling will continue to be used. Probably most Western mills now sample at from 20c. to 60c. per ton, but with better mills and more efficient operation the work should be done at about half the present cost.

(To be Concluded)

TRAVELERS reaching Chihuahua will now be able to secure comfortable and modern hotel accommodations. Electric lights and all other modern conveniences have recently been installed, according to the American Vice-Consul. Rooms can be had for from $2 to $5 per day. Table d'hôte meals are served in an up-to-date dining-room at a charge of $1.50 per meal.

The Sinking of the Alpha No. 2 Shaft at Kimberly, Nevada

By H. S. Munroe

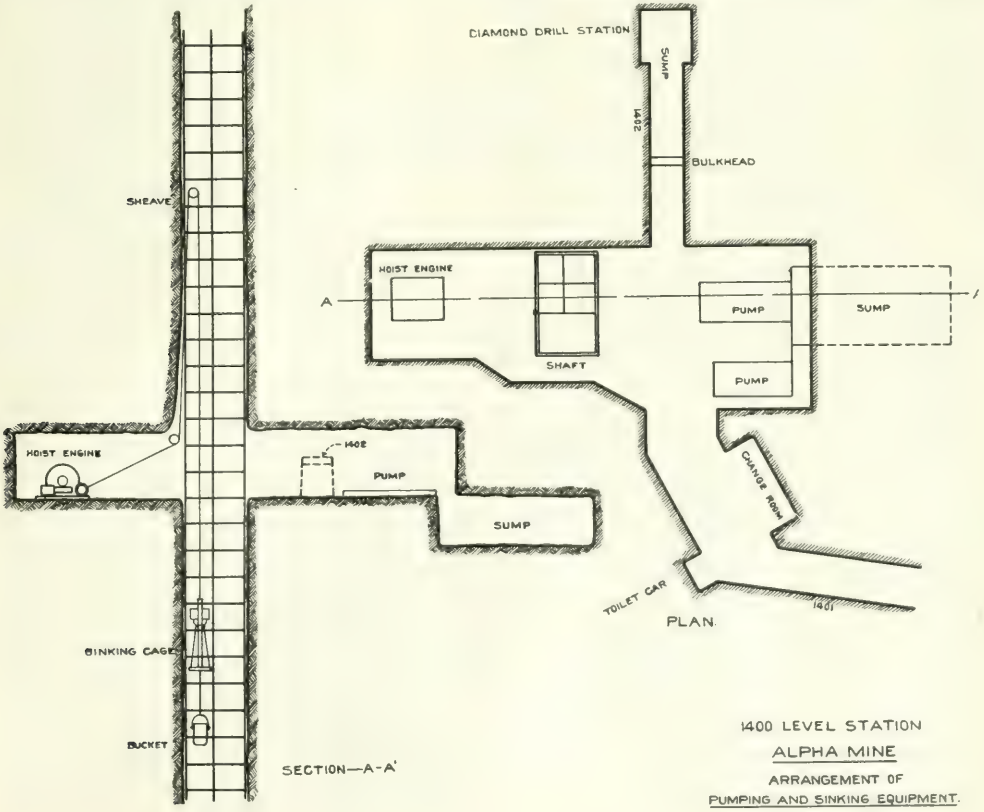
After a diamond-drilling campaign, by the Consolidated Copper Mines Co., conducted from the 1300 and 1400-ft. levels of the Alpha mine, it was decided to sink the main or No. 2 shaft from the 1400 to the 1800-ft. level.

On account of the extraordinary overhead expense involved in sinking from an underground station, and the delay such sinking would occasion to the normal operation of the mine, it was planned to get all possible speed on the job once the work was actually started: first, by providing and maintaining the best available equipment, and, second, by making the wage attractive on a sliding-scale contract so that the good men we hoped to provide would not only stay on the job but would take a lively interest in it, and, third, by making provision against delays that might be caused by the rather heavy flow of water in case of ordinary pump difficulties.

The rock in which this shaft is sunk is limestone, varying from a dense hard blocky phase to more shattered comparatively soft rock. In its shattered phases there is more or less silicification.

The water-level of the mine is at the 1000-ft. level and the normal flow from the 1400-ft. level is approximately 800 gal. per minute. Of this amount all but 100 gal. per minute originates in the altered ore-bearing zone, which is at an average distance of 500 ft. north of the shaft. The mine is kept free of water by compound-condensing steam-pumps, which are not over-capacity and are subject to occasional stoppage. To provide against delays occasioned by pump-stoppages, a concrete bulkhead with regulating-valves was established on the 1400-ft. level. This installation was utilized on five occasions during the four months of sinking.

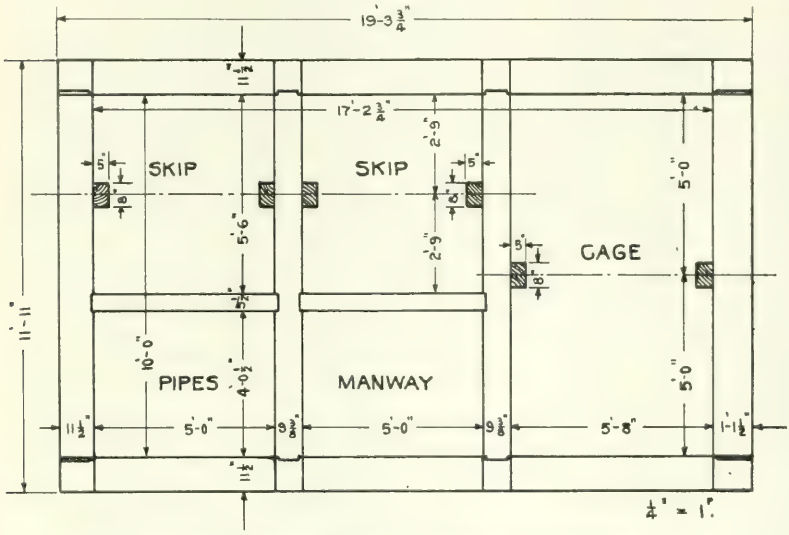
On account of the position of the pumps and sump on



1400 LEVEL STATION
ALPHA MINE
ARRANGEMENT OF
PUMPING AND SINKING EQUIPMENT.

the skip side of the shaft on the 1400-ft. level, it was impossible to cut a loading-pocket on that side. Similarly, on account of the sinking-compartment (designated on the sketch as 'manway') and the pipe-way intervening between the sinking-station and the skip-ways, it was equally impossible to provide a pocket for direct loading into the skips from the sinking-station. It was necessary therefore to revert to the time-favored Butte custom of installing hinged doors at the collar of the sinking-compartment. The buckets were dumped directly into cars run onto these doors.

A 10 by 14-in. air-operated geared hoist with two 300-



ALPHA No. 2 SHAFT. ACTUAL DIMENSIONS; TIMBERS SIZED

cu. ft. air-receivers was installed at the sinking-station. A specially designed light-weight sinking-cage with 12-ft. extension-shoes was provided. A 20-cu. ft. bucket, of which three were provided, was suitably suspended from the deck of the cage.

For drilling, Denver Rock Drill Co.'s No. 59 'Clippers' were provided. These drills were new at the start of the sinking and were taken on top and completely overhauled after each round. At least one spare drill was kept on the sinking-station during the drilling shifts to ensure against delays. No delay on account of drill failure was recorded.

Water from the bottom of the shaft increased from 40 gal. per minute at the start, to about 140 gal. per minute at the finish; it was pumped by No. 7 and 9B Cameron sinking-pumps, of which a spare was kept available on the sinking-station at all times. To provide for the settling out of the worst of the solids in the water from the shaft, the diamond-drill station shown as 1402 in the sketch, was converted into a sump by the construction of a bulkhead; from behind this bulkhead the water overflowed into the main pump-sump. The auxiliary sump filled with mud several times during the period of sinking and this mud was sluiced directly into the skips as provided for in the construction of the bulkhead.

The matter of personnel was given careful attention. A crew of 18 experienced shaft-men was picked for this work. It is an interesting fact that only two men changed during the entire period. These men worked on a sliding-scale contract and made attractive wages. The crew, per shift, consisted of six men in the bottom, one of whom was rated as a shift-boss and received one dollar per shift in addition to his contract wages. In addition, there were one pump-man, two bucket-dumpers, and one hoist-engineer per shift, all of whom worked on day's pay. It is believed that the men in the bottom augmented, from their earnings, the pay of the others. There was excellent co-ordination of effort between the men on a given shift and keen, though friendly, competition between the three shifts. It would be hard to imagine more harmonious working conditions.

Sinking started on November 12, 1919, and was finished on March 5, 1920, the operation having proceeded without any delay worthy of mention and without any serious accident. Much credit for the net result is due R. B. Brown, mine foreman in charge of operations at the Alpha mine.

A statistical table covering this operation follows:

Feet advanced	400
Mine-shifts worked	312
Man-shifts worked (in bottom)	1,812
Total time:	%
Drilling	18.9
Blasting	7.3
Mucking	49.6
Timbering	16.2
Special	8.0
Holes drilled	3,354
Per foot of shaft	8.4
Per mine-shift	10.7
Per man-shift	1.85
Average depth	6.1
Maximum in any one shift	50.0
Feet of hole drilled	20,445
Per foot of shaft	51.1
Per mine-shift	65.4
Per man-shift	11.2
Maximum in any one shift	315.0
Buckets mucked	12,067
Per foot of shaft	30.2
Per mine-shift	38.7
Per man-shift	6.7
Maximum in any one shift	121
Feet timbered	400
Per mine-shift	1.28
Per man-shift	0.22
Sticks of Powder (1 by 8 in.; 10% used	25,450
Per foot of shaft	63.6
Per hole	7.6
Per foot of hole	1.2
Electric caps (No. 8	6380
Per foot of shaft	16
Feet of fuse	18,005
Per foot of shaft	120
Record foot advance per 7-hour shift	123

Objectionable Practices of Minerals Separation

By George L. Nye

*The day of the bonanza is gone. The mining of the metals has developed into an industry in which economical treatment of large tonnages of low-grade material and the elimination of waste are the important features. The evolution of mining has produced a corresponding change in the manner of ore-dressing and ore-concentration.

Experimenters and investigators have been steadily in the field, and as far back as 1884, they were seeking to take advantage of the well-known affinity between metallic particles and oily substances, plus the buoyancy of oil in water, as a means of separating metal from gangue. Experiments and investigations were constant and widespread, but no satisfactory process, that is, none that was at the same time both efficient and economical, had developed until fifteen or sixteen years ago, when four processes came into commercial use, at practically the same time, in the Broken Hill district of Australia. They were known as the Potter-Delprat, the De Bavay, the Minerals Separation, and the Elmore vacuum processes.

The Potter-Delprat process, since acquired by Minerals Separation, consisted, in a general way, of the introduction of a fine ore-pulp into a pointed box containing hot sulphuric acid or hot salt-cake solution. There was a resulting reaction on the calcium carbonate in the material, producing a great quantity of bubbles, which attached themselves to the sulphide particles and raised them to the surface in a thick coherent froth.

The De Bavay process made use of the 'floating greased needle' idea, but, instead of making a coherent froth, there was a thin film of mineral particles floated off the top of the vessel.

In the Elmore vacuum process, the material to be treated was thoroughly mixed with water, oil, and acid, the combination being then drawn into the apparatus by a suction-pump. The suction released the pressure of the pulp, with the result that nearly all the oil dissolved in the water escaped the solution in the form of bubbles, which attached themselves to the sulphide particles and raised them to the surface in the form of a thick coherent froth. In some instances, calcium carbonate was added to the material.

In 1905 the Sulman, Picard, and Ballot patent, which formed the basis of the process being operated by Minerals Separation, was taken out in England. The same process was patented in the United States in 1906, and is known as patent 835,120, being the patent litigated in the now celebrated Hyde case.

*A paper read before the American Mining Congress at Denver on November 17, 1920. The author is of counsel for the Mining Congress in the proceedings against Minerals Separation before the Federal Trade Commission. The footnotes have been added by the Editor.

In 1905, 1906, and 1907, although the processes mentioned were commercially operating in Australia, but little was known about them in the United States, and it was not until after the patent application of Sulman, Picard, and Ballot, which later became patent 835,120, was applied for, that the use of oil-flotation as a commercial method of ore-concentration was introduced into the United States.[1] The interest aroused was immediate and wide-spread, but the development of the art and its application to commercial uses was not at all in accord with either its possibilities or its opportunities.

Mining-men, the country over, have been free to criticize the policy and practices of those controlling the fundamental patents, who apparently have been desirous of commercializing their ownership, while preserving their knowledge and information as trade secrets.

In taking this attitude, the patent-owners have entirely lost sight of the fundamental basis for patent laws of the United States, found in the constitutional grant of legislative power to Congress, in the following language:

"To promote the progress of science and the useful arts by securing for limited terms to authors and inventors the exclusive right to their respective writings and discoveries."

Referring to this constitutional provision, the Circuit Court of Appeals of the Third Circuit in National Harrow Company v. Hench, 83 Fed. 36, said:

"It is no part of the constitutional scheme or of the patent laws to secure to inventors a profit from the suppression of their creations."

In proceeding contrary to the spirit and intent of the constitutional and statutory provisions as interpreted by our courts, Minerals Separation has resorted to many practices criticized and condemned by the mining fraternity.

These practices may be summed up as follows:

It has suppressed technical information, thus retarding the development of the art.

It has made indiscriminate charges of infringement and has failed at the same time in many instances to point out any infringement.

It has required independent inventors and manufacturers to pay commissions on sales of their own apparatus.

It has discriminated unfairly in royalty charges, has charged and is charging excessive royalties and seeking to fasten such royalties upon the operator beyond the life of its patents.

It has made excessive claims to flotation rights, falsely

[1]The process of patent 835,120 was not applied in this country by Minerals Separation until 1915.

disparaged independent apparatus and threatens lawsuits to coerce operators to sign a license contract.

It compels engineers in its employ to sign illegal and iniquitous contracts, and requires licensees and their employees to assign their inventions to it.

It has injected spies and hirelings into the plants of operators refusing to take out a license; and it has violated the criminal laws by breaking and entering the premises of another and threatens to continue such practices, justifying its actions by its alleged necessities.

Suppression of Technical Information and Retarding the Art

In 1909 and 1910, there was a great scarcity of information concerning flotation, even in London where the process was supposed to have been invented some four or five years earlier (R 1624-40).

At the office of Minerals Separation it was stated that they did not care to give out information. There were no books on the subject and the practice of the art was shrouded in secrecy.

When Theodore J. Hoover sought to publish his book, he was violently opposed by Minerals Separation, which, however, later gave a reluctant consent, and the book finally came out, minus certain excisions insisted on by Minerals Separation (R 1642-3). The excisions, according to Mr. Ballot, were considered necessary in the company's commercial interests (R 563). Private profit had even then begun to outweigh public interest in the prosecution of science and the useful arts.

Dr. Gregory sugar-coats the pill by calling it "self-protection". He says (R 621-2-3):

"I am looking at it purely from a moral standpoint—I would say it was an absolute dereliction of duty on my part if I allowed any employee of ours to go and ruin the prospects of a company just because he wanted to air his views."

He adds, however, that in some instances:

"Where we have been able to satisfy ourselves that it would be innocuous we have allowed it (the publication of information), but it has done us harm nevertheless."

John Ballot, president of Minerals Separation (R 561-565), says:

"Our policy is this: with a company developing and exploiting patented processes, we have licensees using these processes, and we are obligated to pass improvements and inventions on to licensees for use. We are not satisfied with the finality of our process as an invention; apart from exploiting the processes commercially we also try to improve them to make them still more useful. Our business, therefore, is of a secret nature. If we permitted our staff members to write papers and discuss things publicly, what possible chance would there be for us to develop our patents."

In other words, for the sole purpose of facilitating private commercial exploitation of a patent right, Minerals Separation suppresses all information which might be used as a starting point for further development of the art by any one of a thousand brains outside its employ.

All this in the face of the fact that it has been the settled law of this country ever since the decision of the Supreme Court of the United States in Pennock v. Dialogue (2 Peters 1):

"That the primary purpose of our patent laws is *not* the creation of private fortunes for the owners of patents, but is to promote the progress of science and the useful arts."

Dr. Gregory admits (R 624-5) that:

"There is no authoritative work on flotation, either in America, England, or Australia, no book on flotation that I would consider an authority."

If any further proof of the desire and effort of Minerals Separation to suppress information be required, it is found in the fact that some years ago when a publisher[2] was about to print an interview with a prominent metallurgist, formerly a licensee of Minerals Separation, the latter's chief engineer threatened "to raise a red flag" if such publication was not suppressed. When crowded for a reason for his attitude, his only answer was that the author said something about the treatment of concentrates by chloridizing roasting and leaching, and he was thinking of taking out a combination patent for that, himself.

Of course, every one at all familiar with the industry knows that such methods of treatment had been almost in common use for more than a quarter of a century.

That this attitude of Minerals Separation has unquestionably retarded the advancement of the art is affirmed and asserted by practically every mining-man and mill-man who has come at all in contact with the situation.

A well-known San Francisco editor,[3] himself an engineer of wide experience, says (R 1650-51), referring to the advancement of the art in this country:

"It has been extremely slow considering the importance of it. The progress of the art in this country has been retarded by the attempt to impose secrecy upon the experiments and the operations of those using the process by means, of course, of these license agreements and other methods, but more particularly by the effort to tie individual metallurgists to the chariot-wheels of this patent exploiting agency."

Government officials[4] connected with the Bureau of Mines express it as their opinion (R 2067 and R 2395-6), after years of experience and careful observation, that the attitude of Minerals Separation has been to retard the development of the flotation art.

One Bureau of Mines man[5] (R 2053-65) has observed and noted a number of instances where mining companies have refused to consider an additional saving by the installation of flotation because of the repressive tactics practised and the license agreement tendered by Minerals Separation.

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[2] T. A. Rickard, of the 'Mining and Scientific Press'.

[3] Ibid.

[4] Thomas Varley, superintendent Salt Lake Station, Bureau of Mines, and others.

[5] Ibid.

Infringement

In one thing at least, Minerals Separation has at all times dealt with lavish hand, that is, in its indiscriminate wholesale charges of infringement. The company's own records show that it has carried in its "infringement file" hundreds of operators, individual and company, who have never used flotation at all, and in some instances, concerns that have not even had a mill on their property.

Their chief engineer[6] admits that they get most of their information concerning infringement from the technical press and casual information (R 1240, 647). This information is passed on to patent attorneys who send out notices of infringement and threats of suit without further proof of the fact (R 1248). This same engineer admits that not nearly all of those listed as infringers are actually operating flotation (R 1268-9, 1275-78).

Apparently the plan was not only to reach the actual operator, but to throw a fear into the prospective operator at the same time.

The 'holier than thou' attitude of Minerals Separation is well disclosed by the statement of its engineer (R 1212-13-14); in referring to the action of the manager[7] of a certain company, who, he says:

"Came and said that they wanted to take a license with us and settle up for their sins."

and adds:

"He was sinning against the law of using flotation illegally. His statement was the result of a letter which Mr. Henry D. Williams sent around generally to those on the list. They were our list of infringers."

These threatening letters from Henry D. Williams were sent to experimenters (Westcott R 1860), to those using the Callow process (R 1894 Lambourne) and to those operating outside the limits of patent-right awarded in the Hyde case (Hollister R 2330-31). Similar threats were made by representatives in personal interviews (R 1894-2396), yet so far as we have been able to ascertain, the threats were all based upon the broad and all inclusive proposition that Minerals Separation *controls flotation.*

The chief engineer says (R 1152):

"The scope of our patent has been discussed by me with infringers in a general way in that I told them that our patents covered the commercial use of flotation, and that we proposed to enforce our patents . . . Advice to field men has been in a general way that people using flotation are probably infringers."

He also says (R 1247):

"Our investigators went to the operators and obtained information. They did not report what patent was being infringed. They haven't any idea of patents. We have these operators down on our infringing list . . . The elements entering into flotation process which in general infringe our patents are agitation and aeration, and the use of oil and other reagents with the formation and separation of froth, all in an ore pulp containing mineral values."

One of Minerals Separation's field representatives admits that in many instances (R 1828-35) neither the apparatus nor the reagents used were disclosed and yet the operators were classed as infringers.

The former manager[8] of the Midvale Minerals Co. in Utah reports (R 1877) that the representative of Minerals Separation who called on him "got into the subject of infringement immediately".

"He did not state or point out in any way whatever the manner in which we were infringing, but claimed infringement merely by use of flotation. He (R 1885) talked about suits that Minerals Separation had brought against other parties, and was careful to state that all of them had been decided in favor of Minerals Separation."

Another mine manager[9] was informed (R 1897) that the company was going to give the smaller operators "their due", later on.

Still a third[10] (R 1954) was told that suits were being brought on other points than the amount of oil used, and that after the decision of the Supreme Court, Minerals Separation was "going after the protection of their rights".

Another manager,[11] using more than 1% of oil on the ore (R 2326) was told that he was infringing. The representative did not say how, but insisted that flotation could not be used without infringing Minerals Separation patents.

I have given a few of the instances where wholesale charges of infringement without specification, and threats of litigation without actual suits, have been used apparently to intimidate and frighten the small operator.

Independent Inventors and Manufacturers

Another branch of the "exploiting" business upon which Minerals Separation embarked originally, with great eclat, was that of requiring independent inventors and manufacturers to pay commissions on sales of their own apparatus. True it is that this practice has now, in the main, been abandoned, but the facts concerning its pursuit while it lasted are interesting and extremely illuminating in a consideration of the acts and doings upon which this patent exploiting agency is thriving.

In December 1916 (R 1358-78-Exhibits 249-259, inc.), the Stimpson Equipment Co., handling the Janney machine, designed to be operated in flotation concentration, was advised by a prospective purchaser[12] that Minerals Separation was threatening trouble if the purchaser put Janney machines into operation. This naturally caused the Stimpson Equipment Co. to investigate the matter.

[6] E. H. Nutter.

[7] J. W. Hutchinson, of the Goldfield Consolidated Mines Co.

[8] George T. Hansen.

[9] George W. Lambourne, general manager for the Judge Mining & Smelting Co.

[10] O. J. Salisbury, of Salt Lake City.

[11] William C. Hollister.

[12] Engels Copper Co., of San Francisco.

and to request that the attitude of Minerals Separation be disclosed.

Later Minerals Separation was advised that the prospective purchaser was one of their licensees, so that the sale could in no manner contribute to infringement. Stimpson[13] was informed, however, that the chief engineer[14] would see him on his way West, and later was requested to meet the engineer at Ogden, Utah. The meeting occurred, and the engineer then tendered to Mr. Stimpson a memorandum of a proposed contract that might be entered into between the Stimpson Equipment Co. and Minerals Separation regarding the sale of Janney machines. The memorandum was handed to Mr. Stimpson (Ex. 250).

This memorandum is one of the most astounding documents that has ever found its way into print. It provides that Stimpson shall have the right to sell the Janney machine to Minerals Separation's licensees, but requires that he agree not to sell, rent, or lease any flotation machine except to such licensees. It stipulates that Minerals Separation must have a contract enforceable by injunction, and that it (Minerals Separation) shall become sole licensee to sell the Janney machines, but that it will, in turn, appoint the Stimpson company selling-agent. It stipulates that orders for Janney machines must be O.K.'d by Minerals Separation before machines are shipped, and requires that it receive 25% of the gross profit made between net manufacturing cost and selling price.

Naturally such a contract was not acceptable to the Stimpson Equipment Co.; after objection and considerable correspondence, a new form of contract was submitted, which Minerals Separation's chief engineer declared would not violate the anti-trust laws, but this contract contained a provision for a heavy penalty in the event that any machines manufactured by the Stimpson company were used in infringement of Minerals Separation's process-patents. In other words, the effect of the penalty was to close the door to any customers for the Stimpson Equipment Co. except licensees of Minerals Separation. The proposed contract was not signed.

Jackson Pearce,[15] another machine manufacturer, was told by Chief Engineer Nutter that anyone who used one of his machines and infringed, would make him (Pearce) liable (R 2296). Pearce refused to sign the contract submitted, objecting to the clause requiring payment of 10% of the selling price to Minerals Separation and fixing a liability of $10,000 in the event that any Pearce machine was used in infringing operations.

A similar contract was offered to Mr. Ruth,[16] another manufacturer. It was stated at the time by the chief engineer that the contract was the standard form (R 2410) and that he, Ruth (R 2414), was not only an infringer, but worse than an infringer, for he was "furnishing the brains for other men to infringe with". Ruth was also told that he was making a living illegitimately (R 2417).

Royalty Charges

In February 1915 the assignor of Minerals Separation North American Corporation entered into a special contract with the Anaconda-Inspiration group, and in June 1916 special royalty terms were given to the Colusa Parrot Mining & Smelting Co., because the quality of its dumps, the low recovery, and the narrow margin of profit to the company, made such terms equitable in the opinion of the assignor (R 501).

A special agreement was also made with the St. Joseph Lead Co., the Doe Run Lead Co., and the Desloge Consolidated Lead Co. (R 905).

Dr. Gregory explains (R 908) that the licenses issued to these particular companies were special because containing a condition that they would pay a certain sum whether they treated ores or not.

President John Ballot (R 513) explains that in the instance of the Colusa Parrot company the contract provided for a royalty of 6c. for twenty pounds of copper recovered and that his company rebated 3c. He says (R 515):

"We merely agreed to leave the license as it was, the license taken up at a certain rate of royalty. As the royalty was paid and payable we refunded half of it to the owner. The agreement was probably oral, at most an exchange of letters."

It is stated (R 537) that Minerals Separation, in settling with infringers, has adopted the policy of charging the infringer who comes to the office and confesses infringement, double the amount he would have paid if he had taken out a license; then after he had paid for past infringements he is treated and put on the same basis as everybody else who has a standard form of license—he cannot, however, get the Anaconda agreement.

This was the attitude and stand upon which Minerals Separation, in August 1915, tried to avoid a previous agreement with Utah Leasing Co., saying (Ex. 303, Ex. p. 2242):

"The London Board refuse to agree to the 6c. minimum royalty . . . and insist that this material pays a flat royalty of 12c. per ton. This on account of the fact that to grant you this 6c. minimum would jeopardize our contract with the Anaconda Company."

and yet in November 1915 a special contract was granted the St. Joseph Lead Co., the Doe Run Lead Co., and the Desloge Consolidated Lead Co. "with the consent of London", which had "the identical terms accorded Anaconda in their license and private agreement."

It also appears that for several years Minerals Separation was charging one company 50c. per ounce of gold recovered by flotation concentration and another company using substantially the same methods and treating substantially the same character of material during the same interval was charged 25c. per ounce.

It must have been punishment or special privilege, one or the other.

[13] Charles Stimpson, of Salt Lake City.

[14] Mr. Nutter.

[15] Jackson A. Pearce, of the Argo mill, at Idaho Springs, Colorado.

[16] Joseph P. Ruth Jr., of Denver, Colorado.

Excessive Royalties

There can be no question but that the royalties charged by Minerals Separation are excessive. They are in practically every instance based upon metallic recovery; in other words, upon gross recovery from ores treated.

In one instance a company during its operations in 1917 made a handsome profit, about $550,000, and paid Minerals Separation a royalty of $18,652. The following year the same company made a profit of $50,000 and paid Minerals Separation $30,000 in royalties. The third year the same company made a loss of $70,000, but nevertheless paid Minerals Separation $32,800.

If the fees paid for the use of a process bore some relation to the net amount of profit made by the operator, they might show some elements of fairness, but when charges are made upon a basis such that Minerals Separation gets its profit when the use of its process contributes to a loss upon the part of the operator, as well as when he makes a profit, there is something unfair and inequitable if not illegal and illegitimate in the royalty charges.

Field engineers for Minerals Separation have repeatedly reported (R 1766-1832-3) that operators protested royalties as excessive.

Mine-operators all over the West (R 1917-1952-2062-2063 and Ex. 352-2064 2290-2293-2312-2455-2471) protest the excessive royalty charges, characterizing them as prohibitive, and in many instances refrain from using the process because of such charges.

In one instance, after holding out the prospect if not actually promising, a royalty of 4c. per ton of tailing treated, Minerals Separation demanded 6c. per ton, and after tendering a contract upon that basis and selling, to the prospective licensee,[17] Minerals Separation flotation machines, which the licensee fully paid for, later demanded a flat royalty of 12c. per ton upon the statement that a minimum of 6c. would jeopardize their contract with the Anaconda company. The licensee refusing to be boosted a second time, Minerals Separation took the high-handed procedure of refusing to deliver to the licensee the machines which it had bought and paid for, as a coercive measure to produce an acquiescence in an extortionate royalty. In this they were entirely unsuccessful (R 2097, et seq. Witness Strange and Ex. 275 to 345).

The matter finally wound up with the most astounding suggestion from the representatives of Minerals Separation, namely, that the licensee should sign both the 6c. and the 12c. agreement, submit them both to Minerals Separation for a decision, and entrust themselves and their contract to a concern which was then, in violation of decency and fair dealing, withholding the machinery which the prospective licensee had bought and paid for.

Is it any wonder that the licensee brought a replevin proceeding to obtain possession of its own, and that Minerals Separation ultimately failed in its attempted hold-up?

[17]The Utah Leasing Co., at Newhouse, Utah.

Under the terms of the license contract put out by Minerals Separation, every licensee is bound not only to give every invention or discovery made during operations under the license to Minerals Separation, but to bind its employees to assign and transfer any such discovery or invention. The licensee also agrees that he will not without the written consent of Minerals Separation during the continuance of the license use or employ any improvement, modification, or addition to any of the inventions specified in the letters patent within the license which is not the property of Minerals Separation.

Dr. Gregory, referring to the contract of the licensees, says (R 580):

"Now coming back to the contract as I said before, one had difficulty in that direction because it was considered that this contract never terminated, but when I explained to them that this was merely an option, and if you used the process you paid, and if you did not use the process you were as good as not having a contract at all, there was no objection of any kind. We simply made the contract, and said, 'Now go ahead, if you find it convenient for you to use the process you pay us a royalty.' The agreement terminates upon their ceasing to use flotation and it commences again when they start to use it."

In other words, when once signed, the contract is perpetual, and extends the payment of royalties beyond the life of the patent right.

The charge of exacting excessive royalties was confessed by Chief Engineer Nutter when he wrote to Minerals Separation in March 1917:

"I am becoming more and more convinced that our royalties are too high and am getting together data which I think will show that we are losing out financially through charging a royalty which is considered too high. The only argument that I can see is that by maintaining our present position we can hold the Butte and Superior Company up for more than we otherwise might."

Excessive Claims of Flotation Rights

The chief engineer of Minerals Separation thinks (R 1156) that "any use of oil infringes Minerals Separation patents". "All users of flotation (R 1160) are infringers", or, (R 1144) "probable infringers".

He told Manager Martin[18] of the Ozark company (R 1178) that Minerals Separation patents covered "flotation process", that is, all manner of flotation concentration. He keeps all those using flotation on the infringers list (R 1129) upon the general theory that they could not be using flotation in a commercial way without infringing, and says, (R 1267) that it is practically impossible to use oil in flotation concentration without infringement. Furthermore (R 1230) he regards all manufacturers of machines as contributory infringers.

In talking with Jackson Pearce, who was himself the manufacturer of a machine for use of flotation, Chief Engineer Nutter said:

"You are furnishing the brains for other men to infringe with. If they hadn't the flotation machine they couldn't infringe and that would eliminate them. I sup-

[18]George A. Martin.

pose you are aware of the fact that our patents control any number of them. Our patents carry us up into the year 1935, and for fellows like you who are making flotation machines, we have a contract whereby you can manufacture without infringing."

He then offered Mr. Pearce a contract similar to that proposed to the Stimpson Equipment Co. requiring that he only sell his machines to Minerals Separation licensees and pay them 10 or 20% of the selling price for the privilege of being thus restricted in his market.

Falsely Disparaging Independent Apparatus

One of the methods formerly in use by Minerals Separation to coerce the manufacturer of independent flotation machines and compel them to come in and transfer all their rights to Minerals Separation and take in return a mere selling-agent's contract, was to use an ordinary expression, to 'knock' such apparatus and in every way to disparage the same, in the minds of prospective purchasers.

When the Engels Copper Co., late in 1916 and early in 1917, (R 1416) was thinking of installing Janney machines, the representative of Minerals Separation advised the president of the Engels company that before he installed Janney machines he must procure the consent of Minerals Separation, frankly stating, however, that he did not think that the operator could get such consent. When asked what would happen if the operator went ahead without the consent, the reply was that very possibly his license *would be revoked.*

In another instance, one of Minerals Separation's own representatives in the field, in calling upon an operator engaged in installing independent apparatus, had "instilled doubt in his mind that the Hyde machine which he is installing in one of his mills would do the work". (Ex. 157, Ex. page 1476.)

In yet another instance, the Ohio Copper Co. in Utah was using flotation. They had installed a Janney machine and had had the same in operation for about 60 days before a Minerals Separation machine was installed. The mill was treating copper ores which in solution naturally corroded any metallic iron with which they came in contact. The Janney machine was of metallic construction, and at the end of 60 days was naturally less efficient in operation than when new. After the Minerals Separation machine was installed, the two machines were operated concurrently and of course a record of the results was kept. Alfred Frank, manager for the Ohio Copper Co., (R 2557) states: "I did not consider there was any definite period during which there was a test." Notwithstanding this situation, Minerals Separation attempted to make capital and to disparage the work of the Janney machine by circulating unfair comparative results in operation (R 1691 and 4) and this in the face of the fact that the manager for the Ohio Copper Co. states that "the Janney machines did slightly better metallurgical work".

Minerals Separation representatives have repeatedly proclaimed the desire to be of assistance to operators, and always use that as an introductory statement in approaching anyone thought to be infringing, but their ardor to be of assistance cools rapidly after a license is taken out and actual help is often entirely missing.

One notable instance was the experience of the Chichagoff company, where, after repeated effort (R 1399, 1402) to get help from Minerals Separation, they gave up in despair and went to independent experimenters, who quickly gave them a solution that raised their savings 16%.

Threatening Law-Suits to Coerce Operators

Dr. Gregory says very plainly (R 601) that a licensee is ensured against law-suits. The inference is perfectly obvious. Anyone using flotation who is not a licensee is manifestly in danger of litigation. This is particularly emphasized in a letter sent out by Minerals Separation's patent attorney in which he stated:

"You are hereby notified of infringement of my client's patents . . . You are hereby directed to send me a full statement of your infringing operations . . . In default whereof I am instructed to bring suit against you for an injunction, profits and damages, including a preliminary injunction at the commencement of the suit to immediately stop your operations."

According to the statement of Minerals Separation's chief engineer, such a letter was sent out to 250 or 300 operators, when confessedly not more than one-third of them were actually infringing.

One of the field representatives on one occasion called upon the Idaho Mining, Reduction & Transportation Co. at Idaho Springs, Colorado, (R 1740). This enterprising and energetic young man stated to the superintendent:

"We are checking up the infringers, trying to keep them out of metallurgical difficulties and endeavoring to get them to come in and take out a license to avoid any disagreeable business that might follow."

This representative thereafter very naively stated:

"He understood that meant litigation."

Another instance, that of the East Butte Copper Mining Co., after receiving the threat of litigation from patent counsel already referred to, took the matter up (R 2371-3) with their own counsel, and reached the conclusion that they could not afford to get into a fight with Minerals Separation "not because we felt they were in the right—but simply as a matter of expediency".

Then there was the case of the Evergreen Mines Co. (R 2332), absolutely deterred from operation by threats of litigation by Minerals Separation. Their property today is lying idle under a resolution by the stockholders of the company to the effect that they will not re-open the property and commence active operations until they can receive fair and decent treatment from the patent-exploiting agency.

Compelling Engineers in Its Employ to Sign Illegal and Iniquitous Contracts

Theodore J. Hoover, one-time general manager for Minerals Separation, who signed one of their engineer employee's contracts, by the terms of which Minerals

Separation seek to bind the engineers to them not only during the period of their employment, but for all time, characterized the perpetual obligation contract (R 1585) as unjust, immoral, and illegal.

The clause of the contract in question, reads: (R 1589, Hoover, Respondent's Ex. 9).

"He shall also pledge himself to keep in absolute confidence all information acquired regarding the company's business and processes during the time of his engagement, and also afterwards."

The words "and also afterwards" constitute the particularly objectionable features of the contract.

Hoover says (R 1584) that his career has been hampered and rendered difficult for years by those words and by the attempts of Minerals Separation to enforce them.

Mr. Hoover finally sought and obtained the opinion of eminent legal counsel to the effect that such a contract was unjust, immoral, and illegal (R 1582).

Minerals Separation also seek to stop the mouths and hamper the efforts of every metallurgist who enters the employ of a licensee, by forcing upon them a contract similar to that which they enforce upon their immediate employees. (R 1652 *et seq.*).

Compelling Licensees to Assign Their Own Inventions to Minerals Separation

Clause 3 of the license contract, is the clause requiring licensees to assign their own inventions and improvements and the inventions and improvements of their employees to Minerals Separation.

Dr. Gregory very lucidly (?) explains (R 616 to 19) the intention of this clause of the contract. He says in effect that it is intended merely to procure for all their licensees the benefit of new inventions without extra charge. He fails, however, to make mention of the fact that each time a new invention is made by a licensee and turned over to Minerals Separation for inclusion within the list of patents under its control, that the chains of the licensees are forged anew and the period of their slavery extended for the life of such patent.

Many licensees and prospective licensees complain bitterly of this clause of the contract. One of them[19] characterizes it as "giving a warranty deed (R 1917) on the brains of our organization", and all object to being obliged to release the results of their own investigations and efforts to Minerals Separation for its sole benefit.

In 1917, after writing to the company suggesting that royalty charges were too high, Chief Engineer Nutter said:

"Another matter which is in my mind now and which I will mention here—although it does not properly belong in this letter—is this: that it would be better policy for us to delete from our license those clauses which always cause irritation to our licensees and in practise are not observed. I refer more particularly to the embargo on information and to the binding of employees to turn over inventions to us."

[19]George W. Lambourne, of the Judge Mining & Smelting Company.

This statement of Mr. Nutter is important for two reasons, first, as a confession that the company has an embargo on information and requires its employees to turn over inventions; and, second, because he recognizes and asserts that as a matter of business policy the company is making a mistake.

Using Spies and Detectives in Plants of Operators

Dr. Gregory tells (R 653) how Chief Engineer Nutter went right into the plant of the Butte & Superior company. He says they had the doors locked, but Nutter broke in—it was "absolute robbery"—and took some of the stuff (concentrate), and put it into a bottle. "If you get some of the froth you know what they are doing," and then added with the utmost *sangfroid*:

"You have to get a thief to catch a thief."

This characterization of their chief engineer may or may not be entirely acceptable to him, but up to date he has been sufficiently mindful of his complete ownership by Minerals Separation, so that he has made no complaint.

President John Ballot says that they have had occasion, and, unless they are ordered to the contrary, they may have occasion in the future to employ men who will use their ingenuity and skill to get into places and find out what people are doing. "We have to use all the modern methods that everybody uses—detectives. We employ a man to go into the works, anyone that we can get hold of to do the business. We employ a man to go into the works and pay him. Detectives were sort of workmen."

In other words, they employ men outright in the first instance as spies, put them under salary, induce them to go to various operating companies and misrepresent themselves as honest men seeking employment, and thereby worm themselves into the works of an operator, taking their money from such operator as regularly as they get their pay from Minerals Separation for the sole purpose of spying out and reporting the operations in that particular mill.

It is brazenly admitted (R 779) that they had a chief spy located in Salt Lake City, who recommended other spies (R 769), who were employed in at least two instances, and who were characterized as the "northern observer" and the "southern observer". He says, however, (R 773) that they were employed to ferret out instances of stealing, and adds:

"By stealing we mean that they were suspected of illegally using our process patents."

These observers were employed at a total cost of a little less than $10,000.

The arch conspirator, reporting to president Ballot, (Ex. 83, Ex. R. page 1161), says:

"I just want to inform you that I have secured, by devious and most unethical means, a sample of X-cake which I am sending by registered mail to Mr. Higgins today."

When we consider the suppression of information, the indiscriminate charges of infringement, the demands

upon independent inventors and manufacturers, the excessive claims to flotation rights, the disparagement of independent apparatus, the threats of coercion, the strangle-hold contracts imposed upon licensees and employees, and the excessive and discriminatory royalties which are being charged, to say nothing of the outrageous methods employed by this patent-exploiting monopoly to obtain the evidence with which to club non-licensees into submission, is it any wonder that practically the whole mining fraternity has been aroused to that spirit of self-defence which years ago found expression in the words, "Millions for defense, but not one cent for tribute"?

Production of Quicksilver

From April 1 to June 30, 1920, inclusive, 3685 flasks of quicksilver of 75 lb. was produced in the United States, according to F. L. Ransome, of the U. S. Geological Survey. This is 1214 flasks less than was produced in the first quarter of 1920 and 255 flasks less than was produced in the second quarter of 1919. Only 13 mines were reported as productive—8 in California, 1 in Nevada, 1 in Oregon, and 3 in Texas. California produced 2704 flasks, Texas 952 flasks, and Nevada and Oregon together 29 flasks. The average monthly price of quicksilver per flask in San Francisco for the quarter was $100 in April, $87 in May, and $85 in June. The average price for the quarter was therefore about $91 as compared with about $86 for the first quarter. The chief cause of the decrease in production during the second quarter was the destruction by fire, on June 20, of the reduction plant of the New Idria mine, in California, and the consequent loss of quicksilver already reduced during the earlier part of that month. Because of this misfortune the production for the third quarter of 1920 will probably be still smaller than that for the second quarter. Reconstruction is in progress, and it is expected that the plant will be in partial operation in August or September of this year. Other causes that contributed to the decrease in production were a shortage of efficient labor and a reduction in the average grade of the ore. At a time when initiative in the quicksilver-mining industry is at a low ebb and the tendency is rather to abandon enterprises already begun than to embark on new ones it is of interest to note that the formerly productive Klau mine, in San Luis Obispo county, California, has been re-opened under the same management as the Carson mine, and that its 50-ton furnace has been put in repair.

LARGE DEPOSITS of iron ore are uncommon in the northern Rocky Mountains, so that considerable interest is attached to some deposits near Stanford, Montana. The deposits are lens-shaped bodies of rather pure hematite that form a belt along the contact of limestone and an intrusive porphyry. The belt has been traced seven miles, and although the length of the lenses is not accurately known, the widths range from 5 to 60 ft., and one lens is explored 125 ft. below the outcrop.

The New Air-Shaft of the Davis-Daly Copper Company

*Since the Colorado mine became one of the deep mines of the Butte district, that is, after the workings reached a depth exceeding 1900 ft., the problem of efficient ventilation has been difficult. This problem has been met in several ways with varying degrees of success during the past three years. The first step toward obtaining efficient ventilation of the lower workings of the mine was the installation of an electrically-driven fan on the 2500-ft. level. This fan produced a slight, but noticeable, change in the air of the mine. It was not entirely successful, however, because of the fact that the Colorado shaft had to be used to carry both the descending and the ascending currents of air. In other words, it was both the 'downcast' and the 'upcast' shaft. The two hoisting compartments were downcast, and the pump and chippy compartments were upcast. The air was drawn to the 2500-ft. level by the fan and circulated upward through the stopes and upper levels of the mine to the 1400-ft. level, and thence upward through the pump-compartment.

As the workings of the lower levels of the mine became more extensive this system of ventilation ceased to produce the desired effect. A new source of fresh air became a necessity, and it was decided to connect with the Belmont mine of the Anaconda Copper Mining Co. To make this connection, a cross-cut 1000 ft. long was driven east from the Colorado 2500-ft. station and a similar cross-cut, approximately the same length, was driven west from the 2800-ft. level of the Belmont mine; the two cross-cuts being connected by the Colorado-Belmont raise, 185 ft. in height. This connection was made at a cost of approximately $60,000. The ventilation problem of the Colorado mine was once more solved, and an ample supply of fresh air was obtained from the Belmont connection. The effect of this new supply of air upon the atmospheric condition of the mine was gratifying. Stopes which were previously devoid of ventilation now had a good supply of fresh air coursing through them. Since the 'holing' of the Belmont raise, however, the mine gradually grew until this source of supply was no longer adequate. The question now arose: What shall be the next step toward efficient ventilation and a new source of fresh air? It was then decided that the Colorado mine should have its own downcast and upcast shafts, and thus an adequate, efficient, and flexible ventilation system. At the present time a new shaft has been started which, when completed, will extend from the surface to the 1700-ft. level, a distance of 1800 ft. The shaft is to be octagonal in shape, six feet six inches in diameter inside of timbers, and timbered with solid cribbing. The shaft is now being raised for nine separate places; cross-cuts have been run and connecting raises are now being driven. A No. 14 centrifugal fan will be installed at the collar of this new air-shaft. The Colorado shaft will be made downcast. The supply of fresh air traveling downward through it will return through the new air-shaft.

*From the 'Bornite Sentinel'.

American Operations of the Consolidated Gold Fields of South Africa

In the recent annual report of the Consolidated Gold Fields of South Africa, Limited, an important holding and promoting corporation in London, we find the following account of its activities in this country:

American Trona Corporation

The results of operations for the year 1919 were as follows:

Gross earnings	$1,116,949.09
Potash and borax salts in stock on December 31, 1919, at cost	180,572.58
	$1,297,521.67
Operating expenses (excluding depreciation and interest charges)	1,532,153.49
Operating loss	$ 234,631.82

For the eight months ending August 31, 1920, during which time the new management has been in charge of operations, the results have been as follows:

Gross earnings	$1,187,296.96
Potash and borax salts in stock on August 31, 1920, at cost	138,480.55
	$1,325,777.51
Operating expenses (excluding depreciation and interest charges)	1,012,137.67
Operating profit	$ 313,639.84

There was produced 13,296 tons of potash and borax during the year 1919, and 8511 tons during the first eight months of this year. The potash and borax produced have gradually been brought up to a higher and superior grade and are now readily marketable.

Satisfactory progress is being made toward the solution of the various chemical and mechanical problems. The plant has been considerably simplified and the amount of labor appreciably reduced. Further improvements contemplated should result in increased production and reduced costs.

The plant is being adapted to new operating conditions to as great an extent as possible and the changes required have so far involved comparatively little new capital expenditures, which latter have been paid out of income from operations.

California Trona Company during 1919 marketed 482 tons of crude trona and 777 tons common salt, and during the first eight months of 1920, 440 tons of crude trona and 3193 tons of common salt.

During 1919 the Trona railway, of which the American Trona Corporation owns the entire stock and bonds, showed an operating revenue of $162,457 and operating expenses of $96,054. Interest on bonds and miscellaneous deductions from income amounted to $35,718, leaving $30,685 net profit for the year. During the first eight months of 1920 the net operating profits were $31,493.

South American Gold & Platinum Company

Efforts of the management have been directed largely toward the equipment of the various properties and the operating results have not been representative of what shortly may be expected. Now that war-time conditions are being overcome and both labor and materials are in more plentiful supply, it is confidently anticipated that this work will proceed much more rapidly in the future than it has in the past.

During the year 1919 the operations of No. 1 dredge yielded 6349.2 oz. platinum and 972 oz. gold of an approximate value of $700,000. This is a satisfactory recovery in comparison with the previous year's results in view of the fact that the dredge was closed down for extensive repairs during two months of last year. It is of interest to report that, despite a complete shut-down for repairs in January, the production for the first eight months of 1920 has shown a substantial increase over the same period of 1919.

Dredge No. 2 was completed and began digging on August 16 of this year. It is now digging its way out of the pond in which it was constructed, and toward the ground which it is intended to operate. This dredge has a capacity very much larger than No. 1 dredge. A third dredge, of even larger rated capacity than the No. 2, is now being fabricated in the United States, and it is expected that this will be erected in time to commence operations by the middle of next year.

This company is amply financed to carry out its equipment program, inasmuch as it now has in its treasury in excess of $650,000 in cash and United States government securities, in addition to which there are considerable sums in the treasuries of its operating subsidiaries, and substantial payments have also been made on dredge No. 3.

Yuba Consolidated Gold Fields

Dredging operations for the fiscal year ending February 28, 1920, are as follows:

		Per cu. yd.
Total returns	$3,213,213	13.66c.
Expenses	1,567,665	6.67c.
Profits	$1,645,548	6.99c.

The 12 months ending February 28, 1920, have been the record year in point of operating output and the number of cubic yards dredged, but owing to the decrease in values the net profit is $316,878 less than the previous year. There was much ground dredged during the year that yielded little, due to considerable channel dredging

in accordance with an agreement with the War Department.

For the four months ending June 30, 1920, the net operating profit was $416,713. The average yield per cubic yard was 11.22c., with expenses averaging 6.16 cents.

Mississippi River Power Company

The results of operations for the year 1919 were as follows:

Gross earnings	$2,321,954.21
Operating expenses and taxes	522,629.71
Net earnings	$1,799,324.50

The gross earnings increased $108,562 as compared with the previous year, and notwithstanding the fact that taxes increased $39,282, and a charge of $53,842 was made for depreciation, the net earnings showed an increase of $32,918. The decrease in operating expenses was due largely to very favorable river-flow conditions which made it unnecessary to buy any steam-relay during the year. It is interesting to note that 80% of the earnings of the company came from public-utility customers, three of them having made new high records for consumption, and initial service having been furnished during the year to several new customers.

For the six months ending June 30, 1920, the results of operations were as follows:

Gross earnings	$1,282,569.42
Operating expenses and taxes	294,572.17
Net earnings	$ 987,997.25

The adjustment of rates under the St. Louis contract referred to in last year's report gives the company additional revenue at the rate of $277,777 per annum from August 1, 1919, to July 31, 1928, inclusive.

This company's power-station development, which spans the Mississippi river at Keokuk, Iowa, has a generating capacity of approximately 150,000 hp., with flowage-land, dam, and station foundations for an ultimate capacity of approxmiately 200,000 hp. The company is furnishing at present 100,000 hp. to the city of St. Louis, neighboring cities, and adjacent territory.

Sierra Pacific Electric Company

The results of operations for the year 1919 were as follows:

Gross earnings	$681,891.38
Operating expenses and taxes	379,752.18
Net earnings	$302,139.20

The decrease in gross earnings of 5½% as compared with the previous year was due principally to the closing down of the copper mines and smelter in the Reno district on account of the unsatisfactory condition of the copper market which followed the close of the War. Prosperous conditions, however, prevailed in Reno, although the shortage of labor and prevailing high prices discouraged building. The electric-light and water business showed a small increase over the previous year, and in the gas business there was a gain of about 4.3% due to increased rates. An increase in power-rates was secured, effective October 1, 1919, for the territory outside of Reno. The combined operating expenses show a slight increase over those of the previous year, due largely to an increase in the price of oil for gas manufacture, and taxes increased 31%.

For the six months ending June 30, 1920, the results of operations were as follows:

Gross earnings	$388,043.97
Operating expenses and taxes	203,349.76
Net earnings	$184,694.21

The gross earnings for these six months were $76,056 more than for the same six months of 1919, operating expenses and taxes $19,770 more, and the net earnings show an increase of $56,286.

The company has recently closed contracts for the sale of additional power to the Southern Pacific Company for its shops at Sparks and to an affiliated company, the Pacific Fruit Express Co., for refrigerating plant. It is expected that the gross revenue from these contracts under which power will begin to be taken early in 1921 will amount to about $35,000 per annum.

Norman Oil Exploration Syndicate

This Syndicate was formed the early part of this year with the small capitalization of $100,000, of which your company owns a 51% interest. The purpose of the syndicate is to purchase oil leases on good geological structure in the State of Oklahoma and adjoining States, with a view to selling these leases later at a profit. Considerable acreage has so far been acquired, the greater part of which has already appreciated in value. Consideration is being given at the present time to an extension of this business.

New Business

During the past year many mining propositions have been submitted to us and considered, but until recently the prices asked have been too high. There is every prospect that we shall in due time be able to acquire interests in new and profitable mining ventures.

It is reported that Hilaro Lazoya, recognized as the leader of mining in the Guanacevi mining district, has formed a syndicate with a capitalization of ₱8,000,000 for the construction of a smelting plant in the centre of the Guanacevi district, one of the leading silver-producing sections of Durango, Mexico. According to official statistics there are over 300 mining properties in this vicinity which produce silver ore in paying quantities. The records of some of these mines show them to have produced extremely rich ore. Many of the old-time American mining men are returning to this district to resume operations. Señor Lazoya is a friend of them all. He is well known in El Paso and other border cities and one of the most prominent citizens of the State of Durango. He was at one time governor of the State and has often been offered responsible government positions in Mexico City but his mining interests would not permit of his absence.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

ARIZONA

WAGES REDUCED TWENTY PER CENT.—PLACER MINES NEAR KINGMAN TO BE OPERATED.

BISBEE.—A reduction of wages, averaging 20%, by all the mining companies of Arizona, including the Bisbee, Verde, Globe, and Miami districts, has been announced. The copper companies of the Globe-Miami district have posted notices on their properties announcing a flat reduction of wages of one dollar per shift in all departments, effective January 21, 1921. The adjusted wage for miners will be $5.15, which, according to the scale agreement adopted prior to the War, is the wage based on 22c. per pound as the selling price of copper. Employees of the following companies will be subject to the reduction: Inspiration Consolidated Copper Co., Miami Copper Co., Arizona Commercial Co., and the Iron Cap Copper Co. No further reduction of working forces is anticipated by the larger producing companies of the Globe-Miami district. A meeting of the Arizona chapter of the American Mining Congress was held on December 6 at Phoenix, and was attended by presidents, general managers, or other chief officials of the principal mining companies operating in the State. It is understood that the question of wages was taken up at this meeting, and that an agreement with regard to the reduction was reached by the various companies represented. No labor trouble is anticipated as a result of reductions, as such action is generally expected by miners throughout the State.

Directors of the Calumet & Arizona Mining Co. arrived at Bisbee on December 8, on a tour of inspection of the company's properties at Bisbee, Douglas, Ajo, Jerome, and Lordsburg, New Mexico. Included in the party were Charles Briggs, president; Thomas Hoatson and G. R. Campbell, of Calumet, Michigan; George A. Newett, of Ishpeming, Michigan; T. F. Cole, of New York; T. H. Collins, of Princeton, Massachusetts; and W. B. Mershon, of Saginaw, Michigan. George A. Newett, who is also the editor of the 'Iron Ore', and one of the best informed men in the country on copper, expressed the opinion that it will not be as long as many think before the copper market shows signs of revival. In this connection he spoke of the possibilities of a great advertising campaign to bring before the consumer the many possibilities and advantages in the use of copper in certain products where other metals are now used. He declared that advertising is a field that has been much neglected by producers of copper.

GOLDFIELD.—A new record in shaft-sinking is aimed at by Willis Lawrence, superintendent of the George Young mine. The work will be done by a crew of five men, all members of the team that beat the world's record last February at the Van Dyke Copper Co.'s property at Miami, where they sank a shaft to a depth of 308 ft. in 31 working days. This beat the record that was established by a crew in the mines at Johannesburg, South Africa, where 279 ft. was made in 31 days. Work on the shaft at the George Young mine has started.

JEROME.—Discovery is reported of a whole mountain of mineral paint, on the Verde river, about 16 miles by air-line north of Jerome. Claims on the property have been staked, and the locators expect to place their proposition before paint manufacturers in the near future. The best quality of paint lies in two veins, one four feet wide and the other 14 in., but it appears that the entire hill is a paint mine and a steam-shovel proposition. At the annual stockholders meeting of the Shea Copper Co., all the old directors were re-elected without opposition. These are: D. J. Shea, R. E. Moore, O. G. Engelder, John Goodwin, all of Jerome, and E. G. Bush, of Tucson. Of 838,542 shares of stock outstanding, 635,152 were represented; 428,946 in person, and 206,206 by proxy.

KINGMAN.—It is said that good orebodies have been opened on the tunnel-level of the Dean mine. About 40 men are now being employed in carrying on development and installing new machinery. Rapid progress is being made in the preparations for sluicing at the Harris placers, 80 miles north-west of Kingman in Jumbo wash in the Black Canyon district. A large pumping-plant is being installed by Shaw & Harris at the river from which water for sluicing is to be obtained. These placers have been known for many years; they are found in a district in which there are a number of important gold veins, among which is the Jumbo. J. W. Prisk, owner of the Home Pastime mine in Mineral Park, has shipped a carload of high-grade gold-silver ore. Development work is to be commenced immediately on the 300-ft. level. Due to faulting, the former owners failed to pick up the ore on this level. Henry Lovin has been appointed receiver by the Hackberry Consolidated Mines Co. by Judge Bollinger of the Superior Court upon the application by the creditors for such procedure. A lease on the mine has also been given to William Neagle on a royalty basis. The receivership resulted from the failure of various interests to agree upon a consolidation scheme and to finance further work. It is reported that a large

tonnage of ore has been developed in the upper levels of the mine. T. Hill and M. Kari have taken a bond and lease on the Rawhide mine close to Bill Williams fork in the Owen's mining district. This property is reported to be one of the oldest mines in the State having been worked in the 'sixties. Thousands of dollars of high-grade copper ore has been taken out by lessees in the past.

COLORADO

REDUCED FREIGHT-RATE ON LOW-GRADE ORE FROM IDAHO SPRINGS IS OBTAINED.—URANIUM DISCOVERY APPEARS IMPORTANT.

ASPEN.—Supplies have been hauled into the Leadville mine, Varney Tunnel, and Camp Yeckel of the Aspen Silver-Lead company on Porphyry mountain, and operation will be maintained during the winter. The Leadville and Varney Tunnel are shipping ore—a heavy zinc carbonate—by motor-truck for consignment to the A. S. & R. smelter at Pueblo. The high-grade carries 60% zinc, but the bulk of the ore runs 30% zinc, 25 to 35% lead, and 30 to 40 oz. silver per ton. The Aspen Silver-Lead company is drifting from the Deane tunnel on the main Silver fault, and will shortly intersect the East & West fault where a rich orebody is indicated by correlation of geological data.

RICO.—The Mt. Pleasant Mining Co. has sent supplies to the Smuggler-Almont property at Denton and will continue developing orebodies already exposed and exploration of new territory during the winter. The mine was a good producer in the past but of late years has not been actively operated.

ROLLINSVILLE.—Trinidad capitalists have become interested in the Moody group near the old town of Gilpin in the Central district. A one-half interest has been purchased in the Baxter, Gold Crown, and Swear-Off claims, Moody retaining the remaining half. Gold-silver ore running as high as $240 per ton has been mined from shallow workings and a tunnel to undercut the vein at depth is projected. The Moody group is about one-half mile south-east of the Perigo, now closed through litigation but with a record of production exceeding $3,000,000.

CENTRAL CITY.—The discovery of uranium ore in the Gold Rock mine in the Russell district is proving-up with development and the streak according to late reports measures 8 in. of solid ore, stripped for more than 20 ft. Tests have shown as high as 50% uranium but a conservative estimate places value of the ore at close to $10,000 per ton. The ore is closely sorted and sacked and the lessees McCampbell and McLain of Colorado Springs will shortly make a shipment to a Denver plant when the actual value will be determined. The same operators recently shipped a five-ton lot to the smelter that returned 20 oz. gold in addition to some silver and copper. A carload shipment of second-grade ore netted $120 per ton. The Rialto mine is being unwatered by a syndicate of Denver and Wyoming operators. The shaft is 700 ft. deep and the water has been lowered 200 ft. The property, when operated some 30 years ago, produced good ore.

The Rara Avis has been drained by St. Louis people and production from this mine in Eureka gulch will shortly be resumed. Samples taken have shown as high as 25 oz. silver, 1.90 oz. gold, and 48% lead. A heavy sulphide ore assaying as high as 25 oz. gold, 36 oz. silver, and 10% lead has been opened by contractors sinking on the Claire Marie. The property is well equipped with machinery and is being operated by Boston capital. Sulphide ore has been opened up in the Barrick tunnel of the Saco de Oro company at Apex and development work on the vein is planned.

IDAHO SPRINGS.—Close to 50 tons daily of mill-ore is handled at the concentrating plant of the Gem company and is resulting in about six cars monthly of concentrate of a good grade. The company is doing extensive development and has opened an ore-shoot at the 6th level of the Freighter's Friend 100 ft. in length. The ore is of good milling-grade. The Idaho Springs Chamber of Commerce has successfully negotiated a low rate of 75c. per ton on ore shipments valued at less than $30 per ton. Most of the ore shipped from the district comes under this classification.

LEADVILLE.—The Blaine shaft has been sunk to the 350-ft. level, a station cut and drift started to a point under the orebody opened in levels above. The mine continues production of 50 tons daily and with the new level opened production will be doubled. The ore is shipped to the A. V. smelter. Lessees of the Emma & Mabel placer adjoining the Gold Leaf are extending the tunnel to the quartzite-lime contact, where they are confident an orebody will be found.

Zinc-oxide ore has been opened on the first level of the Fanny Rawlins. The vein on the third level carries only silver, although the mine is in the gold belt. From the second, third, and fourth levels lessees are shipping gold, silver, and copper ore, the highest grade from the deepest level averaging $50 per ton, at the rate of 50 tons weekly. One car weekly of the zinc oxide is shipped to the Western Oxide smelter and the production will shortly be increased.

Lessees at the Chrysolite mine, on Fryer hill, are shipping lead-silver ore running 40% lead with about 11 oz. silver per ton. Other Fryer Hill mines active and producing are the Climax, Dunkin, Amy, May Queen, Little Chief, Ponsardin, Little Pittsburg, Robert E. Lee, and Venture.

TELLURIDE.—Shipments of concentrate during November totaled 102 cars and were distributed as follows: Tomboy 50 cars; Smuggler-Union 40; and Liberty Bell 12. The Vanadium Corporation of America has shutdown, discharged all employees, and sold or removed all stores. Vanadium is practically deserted as about 100 men formerly on the company payroll have or will seek employment elsewhere. The Matterhorn mill of the Valley View Leasing & Mining Co. is reported treating successfully in excess of 100 tons of ore from the San Bernardo property.

MICHIGAN

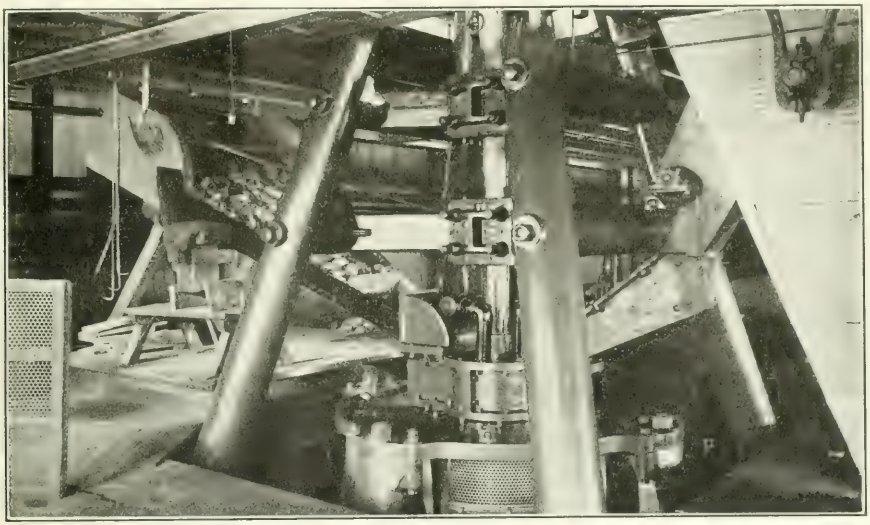
CALUMET & HECLA SMELTER WILL PRODUCE 1,000,000 LB. PER MONTH.—DEVELOPMENT AT ARCADIAN CON.

HOUGHTON.—Copper Range Consolidated is now on a wage and salary basis that will permit it to keep its mines in operation, although there is little hope of making a profit on the present price of copper. During the War, Copper Range, as well as other mining companies in this district, was compelled to bid high for unskilled labor until the quest for workers reached a point where the pay of an unskilled man was about on a level with that of the skilled worker. In the readjustment of wage-scales this situation has been taken into account and the experienced skilled man is the one who suffers the least. The biggest cut has been in the wage of the unskilled worker, the Copper Range reduction in some cases being 22%. The average reduction by Copper Range, however, is 17%. Every effort has been made to relieve the burden of the married man as much as possible. In selling coal to him for $7 per ton and returning $2 to him if he has already paid $9 for it, the company takes an actual loss of $4 per ton, the fuel costing $11. The coal item alone represents a loss of $16,000. In reducing the rent of houses 50c. per room per month, making the rate $1, the company also takes a considerable loss. There will be no curtailment of forces at Champion, Trimountain, or Baltic or at mills or smelter. A few married men from other mines have been given employment at Champion and Trimountain.

At the Calumet & Hecla smelters six furnaces have suspended and two or three more will draw their fires. This will leave in operation 12 furnaces, including two of large type, the capacity of which is 1,000,000 lb. per month. About 150 smelter employees have been let out, while the remainder of the force is employed full time.

Quincy has taken on a few former Calumet miners, but its force is far from normal, and production for 1920 will be considerably below that of 1919. Costs, on the other hand, should compare favorably with those of last year. The re-grinding equipment at the mills was started during the summer, making for an additional recovery of copper. The full benefit of the improvements at the smelter will not be reflected to a great extent this year, but operating at capacity there will be a material saving in smelting and refining costs.

Mohawk's daily tonnage has been increased to practically 2200 tons of 'rock' per day. It is expected that this will be up to 2400 by the middle of the month. In No. 1 shaft, just re-opened, a force of miners is employed in drifting and stoping from the 23rd to the 25th levels. This increases the operating shafts to four, No. 1, 4, 5, and 6, with the largest tonnage coming from No. 4 and 6. No. 1 will contribute materially to production, once the force becomes normal, and it is expected that the tonnage from this shaft will be as great as that from No. 6. In No. 4, 5, and 6 a full program of drifting, sinking, and stoping is under way.



STEAM-STAMP IN A MICHIGAN STAMP-MILL

Arcadian Consolidated is down 765 ft. in its New Baltic shaft. It is sinking 75 to 80 ft. per month and at the depth of 940 ft. connection will be made with the 900-ft. level of the New Arcadian shaft, 3500 ft. distant. The shaft is being timbered, piped, laddered, and railed as sinking proceeds, and the objective, it is expected, will be reached about March 1. New Arcadian at 900 ft. has a drift in 700 ft. toward the New Baltic and drifting will proceed from both shafts when New Baltic is bottomed at 940 ft. One station has been cut in the New Baltic shaft at the 600-ft. level and the next one will be put in

at a depth of 790 ft. It also is planned to connect the two shafts at that depth, which in the New Arcadian is equivalent to 750 ft. The lode was tapped in New Baltic at 250, 400, 500, and 600 ft. and from 600 down the shaft has been in the vein. According to the management, the lode, which is known as the New Arcadian amygdaloid, is uniformly mineralized, with considerable small 'mass' and 'barrel' copper as well. The showing in the New Arcadian shaft is considered equally encouraging. Only a small amount of drifting has been done at points of contact with the lode in both shafts, but enough to demonstrate the uniformity of the mineralization and commercial value of the vein as far as it has been opened. With the connections at the 900 and 750-ft. levels, a large area will be available for mining. The Franklin mill, which is convenient and adequate, probably will be used when sufficient openings are made to warrant actual production.

Mayflower's cross-cuts, east, from the south drift, have stopped after finding the hanging-wall trap and the principal operation now in this section of the 1700-ft. level is a continuation of the drift. At present it is breasted in spotty trap matter. In the raise in the north cross-cut, now about 50 ft. high, the conglomerate vein still appears, with bunches of copper, yet not in commercial quantities, exposed from time to time.

NEVADA

PRODUCTION AT THE WARD MINE IS INCREASED.—GOLDFIELD CONSOLIDATED WILL LEASE BLOCKS AFTER JANUARY 1.

ELY.—Shipments through East Ely from the Ward mine, 12 miles south of Ely, have been increased to 1500 tons monthly and in a short time will be increased again to 3000 tons monthly, according to S. B. Elbert, manager. The company is using five 7½-ton motor-trucks in hauling. Regular shipments to Utah smelters have been made for nearly four years. The decision to increase the output is said to have been due to the recent decision of the Interstate Commerce Commission giving the Nevada Northern railroad permission to reduce rates on low-grade ore.

TAYLOR.—Four suits, two for a total of $2832 and the others for smaller sums, have been filed against the Wyoming Mining & Milling Co., which in 1918 took an option on the old Argus mine for $90,000. The $2800 suits were brought by the Ely National Bank and they are actions to recover on promissory notes. The Wyoming company has built a mill and has done much development work. There has been paid $27,000 on the purchase price of $90,000. The filing of the suits followed the failure of the company to make a $30,000 payment on December 1.

MONTEZUMA.—The Harmill company has erected a hoist, head-frame, and five buildings at the 100-ft. shaft sunk by Moon and Whitaker, from whom the company bought the claims. The shaft is to be sunk to 500 ft. and the first lateral work below the 100-ft. level will be done at 150 to 200 ft. from the surface, or when the junction is reached with the No. 4 vein, in which the shaft is sunk, and vein No. 1, which is thought to dip into No. 4. When the Harmill bought the claims silver-lead ore 3 to 4 ft. wide and assaying $90 to $125 for this width had been opened on the 50 and 100-ft. levels and since then this ore has been found for a length of 35 ft. without reaching the end of the shoot. There are seven veins in the eight claims and three of these can be explored near the shaft. It is reported that $75,000 worth of ore was produced in the early days from vein No. 1 and stopes in the vein indicate that this figure probably is correct. The veins are replacements of limestone. The ore contains lead sulphide and carbonate, copper, and silver, the last making one-tenth of the value of the lead. The ore also contains quartz, calcite, and fluorite. The shipping point is Klondyke on the Tonopah & Goldfield railroad, 15 miles distant.

TONOPAH.—Bullion shipments from the district in the last half of November were heavier than usual, reaching a total of 222,657 oz., exclusive of the Tonopah Mining. The Belmont shipped 99,407 oz.; Tonopah Ex., 51,905; West End, 50,700; and MacNamara, 20,645.

GOLDFIELD.—Sampling of the Meuli lease workings of the Lone Star that were taken over by the company after the richest part of the shoot had been mined shows that there is $30 to $40 ore in the drift faces on the 20 and 60-ft. levels and in a stope from the 60-ft. level. The north drift on the 250-ft. level of the Nelligan shaft has been driven 250 of 280 ft. necessary to reach under the lease workings. The south drift on the 150-ft. level also is being driven for prospecting under the Meuli block. A. H. Lawry, general superintendent for the Consolidated, has announced the following royalties on net returns to be paid by lessees: 10% on ore of a gross value of not more than $20; 15% on $20 to $40 ore, and 20% on ore assaying more than $40. The mines will be opened for lessees about January 1. Ore will be shipped to the Millers plant of the Tonopah Mining and the Tonopah & Goldfield railroad has granted reduced rates between Goldfield and Millers. The Deep Mines has resumed work. The Grandma has added a second shift of miners in sinking the shaft, which is now 910 ft. deep. The flow of water is much less than heretofore and from now on good progress should be made, according to J. K. Turner, general superintendent.

GOODSPRINGS.—It is reported that the Yellow Pine mine and mill are to be closed because of the low price of lead and zinc. The production of the mine is 1600 tons monthly and the company has paid more than $3,000,000 in dividends.

STONEWALL.—The Yellow Tiger is hauling supplies from Goldfield and will resume driving of the Sterlag tunnel.

ROCHESTER.—The Nevada Packard will not be reopened until spring, according to Herman Davis, receiver for the company. The mine was closed last August when the electric power failed at Rochester and surrounding districts because of low water in the Lahontan reservoir

at Fallon. High costs, shortage of labor, and inadequate power are given by the receiver as the reasons for his decision not to resume work during the winter.

Quartz Mountain.—The Goldfield Quartz Mountain Mining Corporation is preparing to start work at Quartz Mountain, a gold district 12 miles east of Goldfield. The starting of work by this company is regarded as of importance because of numerous favorable opinions that have been expressed regarding the claims and because of the highly favorable report made by Corrin Barnes, a Goldfield engineer. No work has been done in the vein except on the surface, where the assays secured by Mr. Barnes were as follows: 8 ft. width, $8; 18 ft., $17; 24 ft., $5.20. The value of the ore is entirely in gold in the form of crystalline flakes in quartz. A tunnel now 160 ft. long will be continued an additional 65 ft. to cut the vein. The company has bought a 25-hp. gasoline-engine and an air-compressor.

Pioche.—Ore shipments for the week ending December 3 show a large increase over those made during the preceding week. The Prince Consolidated shipped 1865 tons; Virginia-Louise, 950; Combined Metals, 305; Bristol Silver Mines, 240; Black Metals, 50; Hamburg Mines, 45; Fairview lease, 40, making a grand total of 3495 tons. Additional men have been employed at the milling plant of the Southern Nevada Mining Co., and it is expected by early spring it will be treating ores. The mill was designed by the late Oscar A. Knox. A contract has been let for additional buildings to be constructed near the milling plant.

UTAH

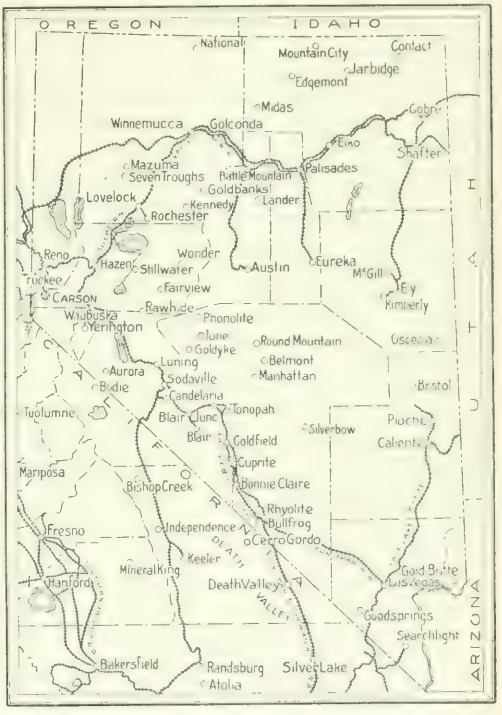
VALUATION OF NON-METALLIC MINERAL PROPERTIES IN UTAH.—REPORT OF BINGHAM MINES CO.

Salt Lake City.—Non-metalliferous mining deposits in Utah have an assessed valuation, for taxation purposes, of $22,686,748 for the current year, which is practically double the assessed valuation for 1917. The coal lands of the State are assessed at $19,091,647; asphalt deposits, $1,062,764; alunite deposits, $274,477; salt and potash deposits, $644,447; cement deposits, $1,372,755; phosphate deposits, $186,195; lime quarries, $31,943; sulphur deposits, $22,530.

During the week ending December 4, the Murray plant of the Utah Ore Sampling Co. released 70 cars of ore from Utah mines, 4 from Nevada mines, and 1 from California, while at its Tintic plant, 42 cars of Utah ore were handled.

A patent has been granted to the Utah Salduro Co. for an area of 30,658 acres of land in the Great Salt Lake desert, title to which was established under placer-mining locations made prior to the date of the leasing law. The company paid an entry fee of $76,645. This entry covered probably the largest area ever patented under one mineral application. The company extracts the potash salts from brine collected by means of an extensive system of dikes, ditches, and canals.

Park City.—Ore shipments from this district for the week ending December 4 totaled 2105 tons, of which the Judge allied companies shipped 865; Silver King Coalition, 596; Ontario, 506; Naildriver, 60; Keystone, 55. The Judge smelter shipped 25 tons of premium spelter. Installation of the new electrically operated compressor and hoist by the New Quincy company at the Little Bell property was completed on December 8, according to A. L. Thomas Sr., manager for the company. The New Quincy company has a five-year lease on the Little Bell shaft and equipment. Work of cleaning out the shaft has been started. Heretofore all work done in the New Quincy property was from either the Ontario drain-level or from the Daly-West company's 900-ft. level. Under



NEVADA

the new arrangement, ore will be taken out through the Daly-West or Ontario properties, and waste through the Little Bell shaft.

Eureka.—During November the Tintic Standard Mining Co. shipped 181 cars of ore, approximately 9000 tons, which is the largest monthly output so far reported by the company. It is expected that December shipments will total 200 cars, and possibly 215 cars. The present output is excellent ore. E. J. Raddatz, president, announces that the new milling plant, with an initial capacity of 150 tons per day, will be ready for operation January 1. The company is earning substantial profits, in spite of the present market quotation of five cents per pound for lead.

During the week ending December 4, ore shipments

from this district were the heaviest of the year, a total of 199 carloads being shipped. Tintic Standard shipped 62 cars; Chief Consolidated, 40; Mammoth, 20; Dragon, 17; Eagle & Blue Bell, 15; Iron Blossom, 9; Victoria, 8; Iron King, 6; Grand Central, 6; Centennial Eureka, 6; Swansea, 4; Gemini, 3; Bullion Beck, 2; Alaska, 1.

At a meeting of the directors of the Eureka-Bullion Mining Co. on December 4, an assessment of one-half cent per share was levied, payable January 5, sales date January 26. The last 60 ft. of work on the 925-ft. level has cut a brecciated limestone, with stringers of quartz, some of which have been rich. One of the veins cut recently was followed several feet and opened up 18 in. of good ore. A north-south fault-fissure filled with sand carbonates and lead boulders has also been entered. One boulder, with an estimated weight of five tons, averaged 58 oz. silver, 54% lead, and $2.40 in gold per ton. Another boulder averaged 107 oz. silver, 40% lead, and $4.40 gold per ton.

At the North Standard property, the shaft has passed the 900-ft. level, according to John Manson, manager. An average of four feet per day is being accomplished. The bottom of the shaft is now in a white limestone, similar to that found in the Tintic Standard. The shaft will reach the 1000-ft. level before the close of the year.

Gold Hill.—At the Western Utah Copper property, gratifying results are being obtained from the development under way on the 300-ft. level. At a distance of 300 ft. from the shaft, 25 ft. of ore, which contains an excess of iron, 5 oz. silver, and 5% lead, has been opened up for a distance of 150 ft. From 150 to 200 tons of low-grade ore is being shipped daily. Up to the present time no sulphide ore has been found. The company's engineers believe that the sulphide zone will not be entered until a point below the bed of the old lake is reached, which will be about the 1400-ft. level.

Bingham.—Operations during the current year by the Bingham Mines Co. and its subsidiary, the Eagle & Blue Bell Mining Co. at Eureka, Utah, have been successful and profitable, according to Imer Pett, general manager. During the first four months of the year, when high prices for silver and lead prevailed and the supply of labor was ample, the companies enjoyed large production and high earnings. The following six months were marked by an extreme shortage and inefficient supply of labor, which curtailed output. However, during November, with an adequate supply of labor and increased efficiency, production has been greatly increased. Development at the Eagle & Blue Bell indicates that the mine will have a long productive career. In the Bingham properties, recent work at depth demonstrates that the ore deposits are as large and their extraction as profitable as was found on the upper levels.

WISCONSIN

REVIEW FOR NOVEMBER.

The serious predicament of the zinc-mining industry of this region through the early autumn was further intensified during November, through declining markets, inclement weather, and bad roads. The mines of the New Jersey Zinc Co., and those of the Steel & Tube Co. of America, have succeeded in maintaining full working crews, notwithstanding the reduction of wages for all classes of mine help. Shovelers' wages were reduced 15%. Millmen, hoistmen, workers on grizzleys, and other mine help came in for a cut of $1 per day. More mine help, apparently, was obtainable in spite of these reductions, as shift-crews held to their jobs all month and the complaints heard relative to a scarcity of men vanished completely.

The offerings on zinc ore at the beginning of the month held firmly, on a base price of $45 per ton, for high-grade refinery blende. This price was declared not satisfactory and furnished the principal reason for trimming miner's wages. A drop in the price was registered about the middle of the month, the base price receding to $43.50 per ton for high-grade blende. In the third week of the month the official sources from which quotations have been obtainable made the disconcerting announcement that no official market figures would be given out. Following this proceeding the Wisconsin Zinc Co., operating a group of zinc mines in the Benton district, suspended operations at its large magnetic-separating plant at New Diggings.

Deliveries of zinc ore for November from mines to separating-plants, in the field, were made by districts as here shown:

District	Zinc, lb.
Benton	7,920,560
Livingston	6,166,800
Cuba City	1,885,840
Galena	1,414,960
Day Siding	842,400
Shullsburg	760,240
Hazel Green	663,120
Platteville	374,800
Highland	60,000
Total	20,088,720

Shipments of finished blende to smelters from refineries were made as follows:

Company	Lb.
National Zinc Separators	2,826,000
Mineral Point Zinc Co.	744,000
Block-House Mining Co.	234,000
Total	3,804,000

No concerted movement designed toward a complete shutting down of zinc producers was heard, although reports were frequent that certain mines would suspend production and discharge working forces. No single instances were recorded to indicate that such a course was intended, and all active producers continued mining and milling.

Lead ore was in poor demand all month. A sharp decline in offerings came about the middle of the month, the price receding from $65 per ton, 80% metal content, to $55 per ton. Producers refrained from consulting the market, with the result that only 45 tons was marketed for the entire month, this negligible quantity

going to the Federal Lead Co. Production was fair and with ore long held in bin brought the reserve at the close of November to more than 1000 tons.

BRITISH COLUMBIA

THE PRESENT STATUS OF THE COPPER-MINING INDUSTRY

VICTORIA.—The slump in the price of copper has hit the mining industry of this Province badly. Two weeks ago cessation of production at the Britannia mine was reported; recently the Granby Consolidated M. S. & P. Co. has laid off 400 men. This means, of course, a curtailment of production, and at a time when money is needed to meet interest on bond issues and taxes. The Granby company has outstanding at the present time two bond-issues, totaling $4,003,300, upon which the annual interest amounts to $290,198. These bond issues were made necessary mainly to pay for the purchase and equipment of the Cassidy colliery, the company's title to which is being disputed at the present time by the Esquimalt & Nanaimo Railway Co., and the coke-ovens, at Anyox. From a metallurgical point the colliery has not been an unmixed success. The coal gives a high-ash coke, necessitating additional fluxes in the blast-furnace. At the present time the colliery is turning out upward of 20,000 tons of coal per month, a large proportion of which is being sold in the open market, and, with coal at present price, should bring a good return, but unfortunately for the Granby company this rate of output cannot be continued for long, as the court limited the total output to 100,000 tons, pending the result of the appeal. During the last fiscal year, ended June 30, the Granby company produced 23,127,847 lb. copper, 938,292 oz. silver, and 14,616 oz. gold; the bulk of the silver, however, came from the Dolly Varden ore, and 95% of the proceeds from it had to be paid to that company. During the second half of this year up to the present time the rate of output has been increased, the September and October output being close to 2,300,000 lb. each. It is claimed that the Granby company can produce copper for about 11 cents per pound, but this does not include payment of interest on bonded indebtedness or taxes, and these two items must add at least another three cents, bringing the total cost so close to the present market price of the metal that it is evident there is little, if any, profit in its production. The only other copper producer of importance is the Canada Copper Corporation. This concern has again reorganized, the second time within a few months, and this time has obtained a Dominion government charter, authorizing it to take over the existing properties as a going concern.

The authorized capital is $10,000,000; the company's head office has been moved to Toronto. The plant was started in the latter part of October, but evidently no effort is being made to bring it up to full capacity with the price of copper where it now stands. The plant is treating 800 tons daily and producing 50 tons of concentrate. It is too early as yet to say whether this is being done at a profit, but considering the grade of ore that is being treated, the railroad haul to Trail, and the smelting charges, it seems doubtful. Considering the ore-reserve is only 12,000,000 tons of about 2% ore, the capitalization seems excessive. The only other producer of copper is the Consolidated Mining & Smelting Co., which owns considerable copper areas on Vancouver Island as well as its gold-copper properties at Rossland. The values in the latter ore are in the gold rather than in the copper. During the unsatisfactory condition of the copper market since the Armistice the company has confined its copper operations to the development of the mines, and concentrated its energies on the more profitable enterprise of producing zinc; lead and silver coming largely as a by-product to the operation.

KASLO.—There is a revival of mining at Slocan, the richest silver-lead district in British Columbia. For months all the large producers have been closed down, with the exception of the Silversmith Mines, Ltd. (old Slocan Star), because of the refusal of the operators to

PART OF CHIHUAHUA AND SONORA

meet the demands of the men with respect to wages, accommodations, etc. They regarded the requirements of their employees, as expressed through an organization known as the 'One Big Union', as extravagant, and refused to take them seriously. A strike was called. There is no doubt that it was effective, for the mines were forced to inactivity. When the strike was first declared work was plentiful, as the lumber camps were able to absorb practically all able-bodied men who wanted employment. These camps now, in many instances, are closed down. There also is an influx of labor from the prairie provinces. The mines, therefore, are well provided with men and the old-established properties again are being put on a producing basis. The Noble Five mine at Cody has taken on a crew of between 65 and 70 men; the McAllister has obtained all the men required to carry on work planned; the Rambler-Cariboo has a full crew; the Rosebery-Surprise Mining Co. has re-opened the Surprise mine at Sandon as well as the Bosun at New Denver. The concentrators of the Rambler-Cariboo and the Noble

Five are in operation. It seems, therefore, that the strike is definitely broken and that the output of this section of the Province from this date on will begin to climb.

NELSON.—At the International Mining Convention held at Nelson during the summer it was resolved that the Dominion government should be asked to make provision for the prospecting and mining of base minerals on Indian reservations in this Province. As a result of the joint action of the Federal and the Provincial governments it is permissible at present to mine the precious metals on such reservations. This privilege is considered of little value in British Columbia.

ONTARIO

SUNDRY COMPANIES PASS DIVIDENDS.

COBALT.—Low quotations for silver and a shortage of electric power has caused considerable curtailment of work in the district. The Mining Corporation has announced that the company will not disburse the regular 12½c. dividend for the current quarter. The McKinley-Darragh has also announced that the regular 3% dividend, formerly payable January 1, will not be paid. The Temiskaming Mining Co. has ceased operations until next spring, and is disposing of its stock of supplies. The Kerr Lake is considering the question of curtailing work somewhat, while other mines are hesitant as to future policy. Wages are now the highest in Cobalt's history, in spite of silver being quoted at about one-half the high figure reached last January. A surplus of men exists and it is considered likely these men may volunteer to work at lower pay in order to induce the mining companies to continue operation. The Nipissing and the O'Brien are still able to produce silver at a cost of under 50c. per ounce.

A station is being cut at the 385-ft. level of the Chambers-Ferland mine preparatory to sinking a winze through the layer of slate to the underlying conglomerate. The high silver content of the stringers in the slate are believed to indicate the presence of a high-grade vein in the conglomerate. Sinking operations are under way on the Regent property, in the Elk Lake district. The shaft is down 35 ft. and silver occurs in a narrow vein all the way down. A small mill-test run of ore is being made this week.

KIRKLAND LAKE.—With the completion of the new mill of the Wright-Hargreaves, which will be finished at the end of the year, an important producer will be added to the list in the district. The Wright-Hargreaves property, about three-quarters of a mile in length on the main belt of mineralization, lies between the Lake Shore which has an annual production of over $500,000, and the Tough-Oakes which, before it became involved in litigation, yielded nearly $750,000 annually. The opening of the mill will depend entirely on the ability to obtain power. The Lake Shore has been able to keep its tonnage up to normal by the use of an auxiliary steam-plant. At the Ontario-Kirkland a good orebody is being opened up on the 450-ft. level, the vein improving with development. Ore is being mined that is soft and easily milled.

WEST SHINING TREE.—The main vein on the Herrick has been traced for 1000 ft. Diamond-drilling has proved up the orebody to a depth of 800 ft., at which point the vein was 20 ft. wide with an average gold content of $15 per ton. A shaft has been put down to a depth of 108 ft., a cross-cut from which has cut the main vein, which is reported as being rich.

BOSTON CREEK.—At the Miller Independence, A. G. Burrows and Percy E. Hopkins, Ontario government geologists, have been making a close examination of the formations on the lower levels. They devoted special attention to the faulting at the 500-ft. level which is probably a continuation of the fracture found in the 'D' shaft, where rich showings of gold tellurides were found.

MATACHEWAN.—A report by H. C. Cooke of the Canadian Department of Mines on the Matachewan gold district noted the occurrence of peridotite in considerable quantities. This formation is favorable for the presence of asbestos, as well as garnets, platinum, and diamonds. Asbestos is known to occur in the district and in the hope of finding it in commercial quantities English interests have engaged J. B. Tyrrell, mining engineer of Toronto, to examine the deposits. The peridotites of Matachewan are stated to be similar to those of the diamond fields of South Africa, which are also associated with garnets, magnetite, and limonite, so that a close exploration may possibly lead to important discoveries.

MEXICO

SITUATION IN CHIHUAHUA.

CHIHUAHUA.—Mining companies in Mexico are beginning to feel the effects of the fall in the price of silver, copper, and zinc. The depressing effects of a drop in prices came just at a time when a big revival of mining operations was beginning to be manifest. While the larger companies will continue to mine ore there are many smaller concerns that are dependent upon immediate shipments to continue development work which will have to shut-down soon. The Government has signified its intention of affording all possible relief to the mine-owners in the present situation. Taxes on low-grade ores have been materially reduced in order that mines of this character may continue operations. The fuel situation is also working a hardship upon the mines and smelters. The protracted strike of the coal miners and coke burners in the State of Coahuila has caused a severe shortage of fuel in some of the mining districts. An exception to this rule, so far as the working of the mines is concerned, is in the districts where electric power is available. In the Guanajuato district, where the mines and mills have for several years been supplied with electric power, these industries are flourishing. The districts in the State of Chihuahua, which obtain their electric power from the great hydro-electric plant of the Mexico Northern Power Co. at Boquillas on the Conchos river, also are suffering no ill effects of the fuel shortage.

THE MINING SUMMARY

ARIZONA

Miami.—Drilling has commenced on the Warrior Copper Co.'s ground in Lost gulch north of the Globe-Miami Copper Co.'s property. One diamond-drill has been installed. Other drills have been arranged for and will be placed as soon as drill No. 1 is well under way.

Prescott.—The Lucky Strike Mining Co., which was incorporated in August of this year and which acquired the Lucky Strike mine and 16 claims in the Hassayampa district, is pushing development work rapidly. Buildings have been completed and the cross-cut adit is in about 80 ft., two shifts of men being employed in this work. The surface shows ore that assays well in gold and silver. This ore, it is expected, will be cut by the tunnel at a depth of 150 to 250 ft. Plans are now being made for the construction of a 50-ton mill to be erected in the spring. Ore running as high as $30 per ton is reported to have been opened by recent work on the Queen claim.——The Philadelphia Mining Co. has taken over the War Eagle-Gladiator property at Crown King on a five year lease. A cross-cut from the Philadelphia mine, which is adjacent to the acquired property, is to be run to the Gladiator vein. The ore is gold-silver-copper.——The Arizona Standard Copper mine, 14 miles north-east of Prescott, is hauling machinery for the 125-ton leaching plant. The crushing plant has been designed to crush double this tonnage. It is claimed that there is a large tonnage of 3 to 7% oxidized copper ore available. T. J. Carrigan is general manager.——Ore assaying over $22 per ton in gold and silver has been opened at the Black Horse mine of the Peak Silver Mining Co. in the Senator district. A new shaft which was started a month ago 600 ft. to the north of the old shaft, has opened a four-foot vein containing high-grade shipping ore.

CALIFORNIA

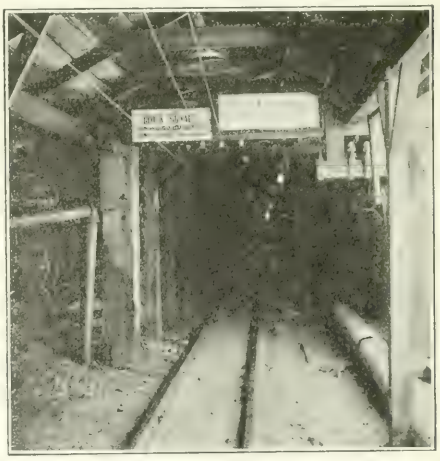
Alpine County.—The gold-quartz mill used at the Hercules mine at Loope is being dismantled and the materials shipped to Reno. This property is owned by the Moffat-Humphrey Co., which operated the mine and mill for a time, but later decided to abandon plans for its development.——The Curtz mine is being re-opened and the old workings cleared out by the new owners, E. Farrell and associates of San Francisco. It is stated that this work is preliminary to development next season when a large crew of miners will be employed.

Nevada County.—A complete fire-fighting system has been installed at the Idaho-Maryland mine, and the first fire-drill has been held. The system makes it possible to use ten streams of water at one time, and by the aid of powerful monitors the entire plant can be swept. This mine is under the pipe-line which conveys water to the Empire and North Star mines and has a strong water-pressure.——The stamp-mill of the Idaho-Maryland has been started up and ore from the old Eureka mine, worked out and closed more than 40 years ago, is being reduced. The ore is being mined by lessees and is of good grade. The present operations are between the 300 and 400-ft. levels of the old mine, that section having been re-opened and explored through the Idaho-Maryland shaft. It is stated that no large bodies of ore have been discovered so far. The work of unwatering the canyon shaft in the Idaho-Maryland mine continues, the water-level now being at the 1300-ft. station. It is understood that while no extensive explorations have yet been found practicable, a shoot of ore indicated by the old maps on the 1000-ft. level has been found and appears highly promising.

Ubehebe.—A representative of the United States Smelting & Refining Co. has agreed to treat ore from the Arrowhead Rico mine free of charge and to pay a premium to be agreed upon later, according to Sol Camp, manager for the Rico. The ore is now 9 ft. wide and it is being broken and sacked for shipment over this width. More than 100 tons of ore assaying $100 has been broken at a depth of 80 ft., much of it containing as high as 60% lead.

IDAHO

Coeur d'Alene.—Three new claims have been taken over by the Gold Hunter company, giving the company considerable additional ground that will be of much value. The properties are secured from the Greenough estate. The claims are the Clear Grit, the Paymaster, and the Lost Wonder.——Activity prevails throughout the Mullan district. The Morning mine is opening its old upper workings. Good work is being done by the American Commander, which is now working a double shift. It is driving a tunnel under the shaft toward the Gold Hunter lines.——The first car of ore from the Yankee Boy and Yankee Girl mines, on Big creek, has been shipped and will be followed by a second in a few days. It is gray copper and assays 100 oz. per ton in silver. These properties were taken over recently by the Sunshine Mining Co., organized in Spokane by E. C. Tousley, mining engineer. W. F. Newton is manager at the property.——John Stout, who owns a property 24 miles above Prichard on the north fork of the Coeur d'Alene river, will



ENTRANCE TO KELLOGG ADIT

attempt to bring out by boat enough ore to make a carshipment. His boat will hold 12 to 15 tons. The ore is a copper sulphate assaying 30% copper.

Forty-five tons of ore, the first shipment by lessees of the Western Union mine, gave a gross return of $5151 and a net return of $3716. It went to the Bunker Hill smelter.

MONTANA

Butte.—The North Butte Mining Co. has announced a curtailment of its production by about one-third. Some 450 men were laid off and it is expected to bring the production to between 400,000 and 500,000 lb. per month. The men retained are all married; they will be placed on development work.——Howard Martin, who is leasing the Hibernia from the Davis-Daly Co., reports pay ore in sight and intends to continue producing lead-zinc and silver ore.——The Colorado, owned and operated by the Davis-Daly Co., while having practically discontinued development work, is still keeping two shifts on the 'air-shaft' which is being driven from the 1700-ft. level to the surface.——The closing of the Leonard, one of the largest producers of the A. C. M., has been reported. This means the laying off of around 400 men.——The Timber-Butte mill is also shut-down.

Cedar Creek.—The old Cedar Creek placer diggings, located about 18 miles from Iron Mountain, produced more than $40,000 in the season just closed. The deposits have been worked every year for the last 40 years, and during that period have produced many thousands of dollars. The claims are owned and worked by the Lacasse brothers of Missoula who are recovering the gold by ground sluicing.

Clancy.—Sinking operations are progressing at the Little Nell mine.——At the Pay-Streak mine near the King Solomon group, sinking is also being done and it is announced that the Free Coinage mine of the Amalgamated Silver is to sink further at once.——At the Mammoth mine, new equipment is being installed.

Cooke City.—The Republic, Glengarry, and Irma mines are producing some good ore. It is intended to continue operations throughout the winter; the ore is being hauled to the railroad at Gardiner, a distance of 57 miles, by large trucks.

Jardine.—The Jardine Mining Co. has closed its mine at Jardine, according to a report by H. C. Bacorn. About 40 men were employed.

NEVADA

Eureka.—A streak of galena has been cut in the face of the lower adit, about 850 ft. from the portal, in the Eureka-Nevada mine. When this adit is connected with the upper workings, which can probably be done by raising on ore from the lower to the upper level, this property will have made a good start for a permanent mine, and the haulage distance between the Eureka-Nevada and the railway at the lower end of the town will have been shortened.——The Eureka-Croesus Mining Co. shipped four cars of ore during the week ended December 4. From January 1 to November 30, inclusive, the total shipments of ore from the Eureka-Croesus mine averaged 1.44 oz. or $29.71 gold per ton, besides the silver content.——At the Eureka-Holly the cutting of the station at the 500-ft. level has been finished, and the shaft is now down nearly 40 ft. below that level. The company has been shipping gold ore. The mill is expected to be ready to operate by about the middle of January.

MEXICO

Cananea.—The Cananea Consolidated Copper Co., that announced a complete suspension of operations to take place on December 15, has announced that the shut-down will be delayed until January 15. The extension of time is reported to be due to the success of General P. Elias Calles, acting for the Mexican government, in securing for the company a rebate of $50,000 in taxes.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

Gilbert Rigg is in Burma.

Marshall D. Draper is here.

P. K. Lucke has returned to Mexico City from Europe.

F. Castanier has returned from Korea to Besseges, in France.

Roy N. Ferguson has returned from Poland to San Jose, California.

H. B. Tooker, traffic manager for the Jackling interests, is in New York.

L. S. Cates has returned to Salt Lake City after a trip to Boston and New York.

Charles Butters has gone to Copala, Mexico, and expects to go from there to Peru.

Walter Fitch, president of the Chief Consolidated Mining Co. at Eureka, Utah, is at Washington.

J. E. Bloom, Major U. S. Army, retired, has arrived in San Francisco from Brooklyn, New York.

P. B. McDonald, of New York University, is editing a book on steam-heating for Warren Webster & Co.

H. R. Robbins is at Minneapolis, supervising some ore-tests at the State Mines Experiment Station.

J. D. Shilling, general superintendent of the Utah Copper mine at Bingham, has returned home after a trip to Florida.

B. V. Barton has been appointed assistant general manager for the Bendigo Amalgamated Goldfields at Bendigo, Victoria.

L. V. Waterhouse, formerly mill superintendent at Mount Lyell, has been appointed manager for the Mount Hope, Ltd., in Tasmania.

Louis D. Huntoon and **G. D. Van Arsdale** have formed a partnership, as consulting engineers, with offices at New York and Los Angeles.

W. A. Prichard, manager for the Pato and Nechi dredging companies in Colombia, is on his way to New York, whence he returns to the mines.

G. A. Joslin, managing engineer for the Ramshorn Mines Co., has spent the summer at the mines and mill of the company at Bayhorse, Idaho, and is returning to his office at Salt Lake City.

William Loeb Jr., a director of the A. S. & R. Co., is in Utah visiting the company's smelting plants. **R. W. Strauss,** assistant to Simon Guggenheim, the president of the same corporation, accompanies Mr. Loeb.

L. W. Hope, who has been superintendent for the Eureka-Holly Mining Co. at Eureka, Nevada, for the past three years, is now holding a similar position with the Ocoee Copper Co. at Ducktown, Tennessee.

N. C. Sheridan, general manager for the Snake & Opportunity Mines Co., Hillsboro, New Mexico, will have charge of the Midnight property at Mullan, Idaho, operations having been suspended at the Snake & Opportunity.

OBITUARY

George O. Kelsey, age 59, a mining man of Cherry Creek, Nevada, died at the home of his daughter, Mrs. Adrienne Reeves, at Salt Lake City, on December 10. He was a native of Utah, but spent the greater portion of his life in California and Nevada in the mining business. He is survived by two daughters.

THE METAL MARKET

METAL PRICES

San Francisco, December 14

Aluminum-dust, cents per pound	**65**
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	15.00—15.50
Lead, pig, cents per pound	5.25—6.25
Platinum, pure, per ounce	**$85**
Platinum, 10% iridium, per ounce	**$125**
Quicksilver, per flask of 75 lb	**$55**
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	12.50—15.00

EASTERN METAL MARKET

(By wire from New York)

December 13.—Copper is quiet and steady. Lead is inactive and firm. Zinc is dull and easy.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eights of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence	Average week ending	Cents	Pence
Dec. 7	65.87	43.37	Nov. 1	80.31	52.35
" 8	65.62	43.00	" 8	81.90	54.00
" 9	60.37	39.75	" 15	80.02	53.50
" 10	59.25	38.87	" 22	76.41	49.96
" 11	61.75	40.50	" 29	73.72	48.97
" 12 Sunday			Dec. 6	69.08	44.29
" 13	62.37	40.87	" 13	62.54	41.06

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	88.72	101.12	132.77	July	99.62	106.36	92.04
Feb.	85.79	101.12	131.27	Aug.	100.31	111.35	96.23
Mch.	88.11	101.12	125.70	Sept.	101.12	113.92	93.66
Apr.	95.35	101.12	119.56	Oct.	101.12	119.10	83.48
May	99.50	107.23	102.69	Nov.	101.12	127.57	77.73
June	99.50	110.50	90.84	Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Dec. 7	14.00	Nov. 1	15.08
" 8	14.00	" 8	15.00
" 9	14.00	" 15	14.87
" 10	14.00	" 22	14.62
" 11	14.00	" 29	14.15
" 12 Sunday		Dec. 6	13.63
" 13	14.00	" 13	14.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	23.50	20.43	19.25	July	26.00	20.82	19.00
Feb.	23.50	17.34	19.05	Aug.	26.00	22.51	19.00
Mch.	23.50	15.05	18.49	Sept.	26.00	22.16	18.75
Apr.	23.50	15.23	19.23	Oct.	26.00	21.66	16.53
May	23.50	15.91	19.05	Nov.	26.00	20.45	14.63
June	23.50	17.53	19.00	Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Dec. 7	5.00	Nov. 1	6.92
" 8	5.00	" 8	6.84
" 9	5.00	" 15	6.61
" 10	5.00	" 22	6.44
" 11	5.00	" 29	5.67
" 12 Sunday		Dec. 6	5.24
" 13	5.00	" 13	5.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	6.85	5.60	8.65	July	8.03	5.53	8.63
Feb.	7.70	5.13	8.88	Aug.	8.05	5.78	9.03
Mch.	7.93	5.34	9.22	Sept.	8.05	6.02	8.08
Apr.	6.99	5.05	8.78	Oct.	8.05	6.40	7.28
May	6.99	5.04	8.55	Nov.	8.05	6.76	6.37
June	7.59	5.32	8.43	Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	85 13	71.50	62.74	July	93.00	70 11	49.29
Feb.	85.00	72.44	59.87	Aug.	91.33	62.20	47.60
Mch.	85.00	72.50	61.92	Sept.	80.40	55.79	44.43
Apr.	88.53	72.50	62.17	Oct.	78.82	54 82	40.47
May	100.01	72.50	54.99	Nov.	73.67	54.17	36.97
June	91.00	71.83	48.33	Dec.	71 52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Dec. 7	6.60	Nov. 1	7.54
" 8	6.60	" 8	7.31
" 9	6.60	" 15	6.86
" 10	6.25	" 22	6.66
" 11	6.25	" 29	6.25
" 12 Sunday		Dec. 6	6.14
" 13	6.25	" 13	6.42

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	7.78	7 44	9 56	July	8 72	7.78	8.18
Feb.	7.97	6.71	9.15	Aug.	8.78	7.81	8.31
Mch.	7.67	6.53	8 93	Sept.	9.58	7.57	7.84
Apr.	7.04	6.49	8 76	Oct.	9 11	7.82	7.50
May	7.92	6.43	8.07	Nov.	8.75	8.12	6.78
June	7.92	6.91	7.92	Dec.	8.49	8.69	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date		Nov. 30	55.00
Nov. 16	55.00	Dec. 7	55.00
" 23	55.00	" 14	55.00

Monthly averages

	1918	1919	1920		1918	1919	1920
Jan.	128.06	103.75	89 00	July	120 00	100 00	88.00
Feb.	118.00	90.00	81.00	Aug	120.00	103.00	85.00
Mch.	112.00	72.80	87.00	Sept.	120.00	102 60	75.00
Apr.	115.00	73.12	100.00	Oct.	120.00	86.00	71.00
May	110.00	84.80	87.00	Nov.	120.00	78.00	58.00
June	112.00	94.40	85.00	Dec.	115.00	95.00	....

A NATIONAL BUDGET

Why governmental economy and efficiency, tax revision, and a budget system are essentials preached both at and by Congress, and why it is highly desirable that Congress and the departments should practise them, is again made evident by the preliminary estimates just submitted by the Secretary of the Treasury. He is in this respect simply a messenger, transmitting the department estimates to congressional judgment. Even with all possible paring later, the result will weigh heavily on the American taxpayer, says the 'Boston News Bureau'.

The forecast for the fiscal year 1921-22 is given as $4,068,000,000, exclusive of postal service. This compares with a similar request for $4,473,000,000 for 1920-21, or a retrenchment of $405,000,000. After the supplemental estimates for the current year were in, the total asked rose to $4,672,000,000. Congress pruned this down to an appropriated total of $3,213,000,000. Can Congress again cut off a billion and a half?

The announced intention toward allowances and payrolls is emphatic enough; but the power to act is limited by two obvious factors. One is the degree to which the great bulk of Government expense is a fixed 'overhead' obligation. It has been figured that in tinkering with Federal payroll, considerably less than a dime out of each Government-spent dollar is at stake. The other element is the need to include certain items of assured obligation yet undetermined.

Thus the Government will eventually have to make payment, now delayed and under litigation, of over $400,000,000 to the railroads as guaranty of earnings for the first half-year after return to private ownership. All but a few roads accepted the guaranty. Only a few in the past six months have shown net profits to the Government above the guaranty. Then there are strong political prospects for some further wage-advances sought by needy Federal employees, particularly in the Postoffice. Also there is the question of naval expansion. The President-elect has just declared that we should have the largest navy.

It will not be the simplest among the many vexing problems ahead of Congress to trim down the appropriation totals. How these have grown in recent fiscal years may be illustrated as follows:

1921	$3 213,042 484	1916	$678 677,858
1920	4 850 169 029	1915	674 497,625
1919	25 598 967 517	1914	684 757,276
1918	18 144 861 745	1913	617 382 178
1917	1 178,908,962	1912	634,549 561

How large is the fixed quantity of expense is evident from the fact that of the four billions suggested, almost $1,900,000,000 must go for debt service in interest and sinking-fund, while $265,000,000 is allocated to pensions, to say nothing of army and navy.

Heavy sale by the Bank of France has been an important factor in the decline in silver, the decrease in the Bank's silver-reserves amounted to 5,644,000 gold francs for the week ended December 2.

MONEY AND EXCHANGE

Foreign quotations on December 14 are as follows:

Sterling, dollars:	Cable	3.45½
	Demand	3.46½
Francs, cents:	Cable	5.89
	Demand	5.93
Lire, cents:	Demand	3.55
Marks, cents		1.41

Eastern Metal Market

New York, December 8.

There is a better tone to nearly all the markets, especially zinc and copper. While prices are not generally higher, except in one case, they are all firmer.

The tone of the copper market is distinctly better. Prices are firmer.

The tin market is still stagnant but prices are a little higher.

Lead has gone to new low levels but it is felt the bottom has been reached.

Prices for zinc are considerably higher, a better demand not being met by sellers.

Antimony is a little lower.

IRON AND STEEL

The steel trade had expected to drift through December with buying at the lowest rate of the year and the dropping of prices in practically all lines to the Steel Corporation level makes scarcely a ripple. One effect has been to check cancellations and suspensions through a revision of some contracts with independent mills to the new basis. Adjustment of operations to the curtailed demand goes on both at blast-furnaces and steel-works. Pig-iron output in November was 2,934,908 tons, or 97,830 tons per day, as against 3,292,597 tons in October, or 106,212 tons per day.

At 452,000 tons, iron and steel exports in October were the largest for the year, save in July; but current export orders are less than one-fifth of the year's average, with exchange conditions growing worse rather than better.

COPPER

Copper sold last week at 13.50c., New York, but since then the tendency has been upward. There is less desire to cut prices and more stability is in evidence. Dealers are turning buyers rather than sellers and it is almost impossible to purchase electrolytic copper in the outside market under 14c., New York, for early delivery. All asking prices are 14c., which we quote as the market for early delivery with first quarter at 14.25c., New York. Buying demand has not increased perceptibly but it is expected to develop, as the belief is now general that the bottom of the market has been reached. Production is being or has been curtailed quite decidedly.

TIN

The course of the market continues dull with consumers and even dealers indifferent. There have been no important developments. The only news item of special market interest is the cabled press report to a New York newspaper, but unconfirmed in the trade as yet, that the Malay government has fixed a minimum price on Straits tin equivalent to £226 per ton c.i.f. New York. The meaning of this is variously regarded, some stating it to be a bearish rather than a bull argument or factor. There is almost no trading except the picking of cheap lots when offered. The only sale on the New York Metal Exchange in the last week was 25 tons of Straits tin for February shipment at 34.75c. on Monday, December 6. The New York quotation for spot Straits in the last week has been generally higher, due to speculative operations in London. Yesterday the quotation was 35c., New York, against 33.50c. a week ago. In London yesterday spot standard tin was quoted at £223 10s. against £207 10s. a week ago, future standard at £227 15s. as contrasted with £212 a week ago and spot Straits at £224 5s. against £208 a week ago, which shows the extent of the speculative rise there. Total imports to December 1 this year have been 48,093 tons, against 29,956 tons to December 1, 1919. Arrivals thus far in December have been 1495 tons with 2530 tons reported afloat.

LEAD

The feature of this market has been the announcement of two reductions in the past week of ½c. per pound each in the price of the American Smelting & Refining Co. Late on November 30 the reduction was from 6c. to 5.50c. and late December 3 from 5.50c. to 5c., both New York and St. Louis. It may be said that both the trust and the independent markets are now on the 5c., New York and St. Louis, level. Since this has occurred there has sprung up a good demand which is attracting buyers and there is a feeling that the bottom has been touched. Many inquiries are developing which are spread over the first quarter. Independent producers are not generally selling at the present level, especially for first quarter. There is an evident resistance to any further decline and the tone of the market is better and firmer than in some time.

ZINC

A complete change has come over this market. Demand has improved and prices have risen quite sharply. From a low of 5.60c., St. Louis, last week prime Western is now 6.25c., St. Louis, for early delivery. This sudden change is explained, not by any advance in London, but by a disinclination of producers in general to sell at profitless prices and hence not to meet the better demand that has appeared. This has come largely from galvanizers but, relative to normal times, it is not large. Production has been heavily curtailed. So far as forward deliveries are concerned there is still less of a disposition to sell owing to the belief that the market must advance as well as to no desire on the part of producers to commit themselves to a losing business.

ANTIMONY

The market is a little weaker with wholesale lots for early delivery quoted at 5.65c., New York, duty paid.

ALUMINUM

The leading interest has reduced its price to 26 to 27c. f.o.b. producer's plant for wholesale lots of virgin metal, 98 to 99% pure, for early delivery, while from other sellers the same grade is quoted at 24 to 25c. per pound, New York.

ORES

Tungsten: The absence of business continues. Now that Congress is again in session interest in the tariff bill on tungsten has been revived and there are hopes of its early attention. Quotations continue nominal at $4 per unit for Chinese ore and $5 for Bolivian. In England the ore quotation is 24 shillings per unit.

Ferro-tungsten can now be bought at 59c. per pound of contained tungsten.

Molybdenum: There is no demand and prices are nominal at 50 to 60c. per pound of MoS_2 in regular concentrate.

Manganese: Business is at a standstill with quotations nominal at 42 to 50c. per unit, seaboard. Imports continue high, those for October having been 44,700 gross tons, bringing the total to November 1 to 467,712 tons against 285,274 tons to November 1, 1919.

Manganese-Iron Alloys: There is a distinct absence of business in ferro-manganese and spiegeleisen. American producers of the former are quoting $150, delivered, while the British asking price stands at $170, seaboard, in the absence of any test of the market. Production and imports continue heavy. According to blast-furnace reports in 'The Iron Age' for November the output of ferro-manganese was 23,153 tons or fully equal to former records for the year. Imports in October were 6700 tons, bringing the total to November 1 to 46,739 tons or over twice the imports a year ago of 22,674 tons. Spiegeleisen is inactive at $72.50, furnace, for the 21% alloy.

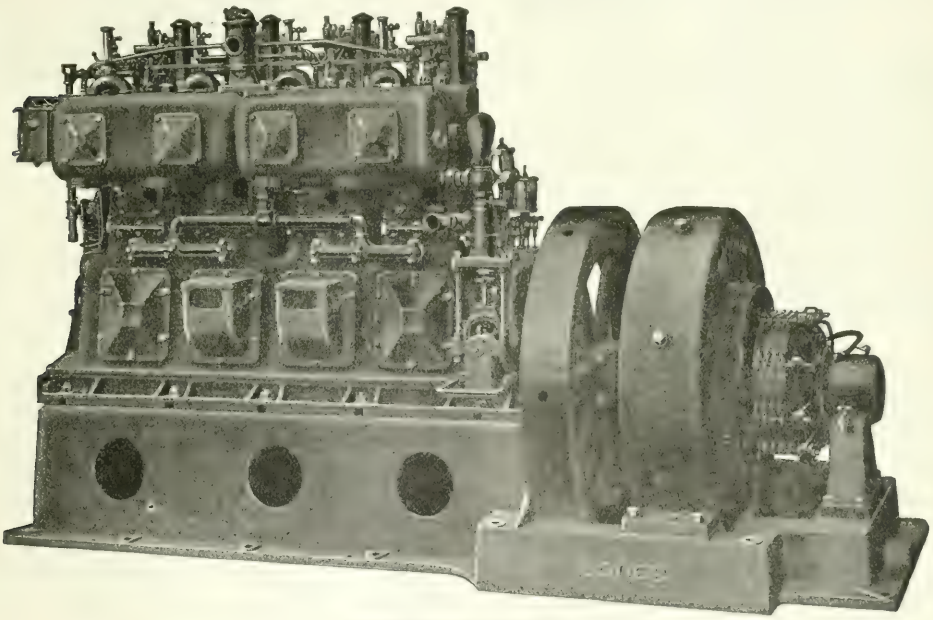
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

DODGE ELECTRIC GENERATING APPARATUS

One of the latest and most notable developments of the Dodge Sales & Engineering Co. of Mishawaka, Indiana, consists of complete power-units for electric generating. The units as made by this organization involve no freak ideas or pet hobbies. Every test made on the complete unit is made in strict accordance with the rules adopted by the American Institute of Electrical Engineers.

The generating units are made up either direct connected or belted in all standard voltages using Dodge heavy-oil engines as motive power. The sizes manufactured at present range from 12½ hp. to and including 75 hp. The wide range of sizes makes the fact evident that the power units are equally adaptable to either marine or stationary power-plant service.



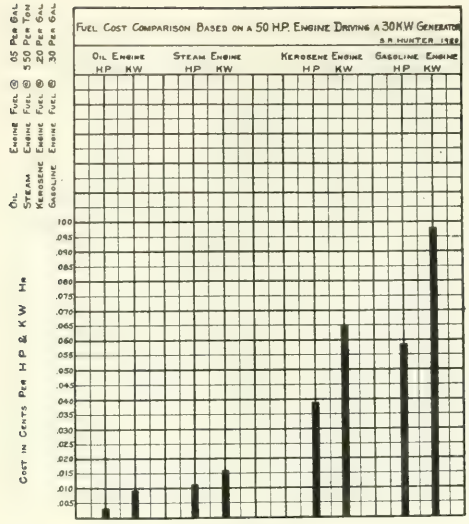
Dodge Oil-Engine Generator Unit

The Dodge heavy-oil engine used is sufficient guarantee of low-cost operation which, of course, results in a great saving in the cost of current generation. The Dodge heavy-oil engine is sold under a standard guarantee which specifies a consumption of fuel-oil of 0.5 lb. per b.hp.-hr., using fuel as low as 0.28°B., containing not less than 18,500 B.t.u. per pound. In fact every Dodge heavy-oil engine turned out must use less than the amount guaranteed on actual brake test; otherwise such a guarantee could not be made with any degree of safety. The figures used in the comparative fuel-cost chart illustrated herewith, however, are based on 0.5 lb. per b.hp.-hr.

The engine illustrated herewith has a brake-output of 50 hp., and is direct connected to a 30-kw., 220-volt, D. C. generator, running at a normal speed of 425 r.p.m. It would therefore use 10,000 gallons of fuel-oil per year, if operated 10 hours per day under full load for 300 days. This fuel costs on the average 5c. per gallon and would mean a total of $500 for annual fuel-cost. This reduces the fuel-cost of current to $0.005 per kw.-hr. The comparative cost-table clearly indicates the economy of the operation of the Dodge heavy-oil engine in direct comparison with coal, kerosene, or gasoline engine-fuel.

Some interesting conclusions are definitely and accurately arrived at in this table. For example, it is found that operating under the same period with a simple steam engine would increase the fuel-cost to $1755, with a resultant fuel-cost of $0.0157 per kw.-hr. The table also contains figures relating to the operating cost of internal-combustion engines of the same horse-power rating and using both kerosene and gasoline as fuel.

The generator used has been developed especially for this particular service by the Engberg Electrical & Mechanical Works at St. Joseph, Michigan. The armature is of the iron-clad ventilated type, with laminated core, being built of


Fuel Cost Comparison Based on a 50 H.P. Engine Driving a 30 KW Generator
A.R. Hunter 1920
Oil Engine HP KW
Steam Engine HP KW
Kerosene Engine HP KW
Gasoline Engine HP KW
Oil Engine Fuel @ .05 Per Gal
Steam Engine Fuel @ 5.50 Per Ton
Kerosene Engine Fuel @ .20 Per Gal
Gasoline Engine Fuel @ .30 Per Gal
Cost in Cents Per H.P. & K.W. Hr.

Fuel-Cost Chart

electrical sheet-steel, thoroughly japanned before assembling. The drum and core are provided with air-ducts, permitting a thorough circulation of air through same.

Nothing but the best double-covered magnet wire of the highest conductivity is used, and the insulation is thoroughly waterproof. A desirable feature in connection with the armature is that it has been so designed as to eliminate a coupling on the armature-shaft, the crankshaft coupling is direct connected to the armature-drum, by such construction

Fuel Cost for 50 H.P. Dodge Heavy Oil Engine Direct Connected to 30 K.W. Generator	Heavy Oil Engine Fuel @.05 Per Gal .5 Lb Per B.H.P. Hr	Coal @ 5.50 Per Ton 1190 B.T.U. Per Lb.	Kerosene Engine Fuel @ .20 Per Gal 1.3 Lb Per B.H.P. Hr	Gasoline Engine Fuel @ .30 Per Gal 1.3 Lb Per B.H.P. Hr
1 Year of 300 Days 10 Hr. per Day	$500.00	1775.00	5909.00	8863.50
1 Day of 10 Hrs	1.66	5.88	19.69	29.54
1 Hr	.16	.58	1.96	2.95
1 Year of 300 Days 1 H.P.	10.00	35.10	118.18	177.27
1 K.W.	16.66	47.10	196.96	295.45
1 Day of 10 Hrs 1 H.P.	.035	.117	.39	.59
1 K.W.	.055	.157	.65	.98
1 H.P. Hr	.003	.0117	.039	.059
1 K.W. Hr	.005	.0157	.065	.098

Comparative-Cost Table

that the engine drives through the armature and not on the armature-shaft. This method of construction is substantial and makes it easy to remove the armature; in fact this can be done without disturbing the engine in any manner whatever. Close regulation is assured by having the flywheel of the engine placed close-up to the armature and on the same end of the crankshaft.

The commutator is made of copper bars, insulated with the best grade of mica plate and is very heavy, thus ensuring years of continuous operation without need of renewal. It is built up on a separate sleeve and bolted to the armature drum, so that the shaft can be removed without disturbing the windings. The bars are collected in a steel chuck, especially designed for this particular purpose, which is provided with large steel screws. The chuck is heated and allowed to expand, at which time screws are tightened to the extreme. When the chuck cools and shrinks, the commutator is drawn into a perfect and lasting position.

Every part of both the Dodge heavy-oil engine and the generator is of the highest possible grade in regard to material, workmanship, and design. All bearings are extremely large and accurately fitted, thus assuring smooth and constant operation with comparatively little attention.

Both engine and generator are carefully tested and inspected at frequent intervals during the course of construction. Both are mounted on a heavy cast-iron sub-base and doweled in place, after which they are subjected to a final operating-test under load.

An indication that concerns requiring electric-generating apparatus have not been slow in appreciating the great economy effected in the use of oil-driven generating-sets is evidenced by the number of orders that have been placed for the units illustrated.

COMMERCIAL PARAGRAPHS

The Chicago Pneumatic Tool Co. announces the removal of its rock-drill manufacturing plant from 864 East 72nd St., Cleveland, Ohio, to the company's Boyer pneumatic-hammer plant at 1301 Second Blvd., Detroit, Michigan. The location of the company's Little Giant air-drill plant at 1241 East 49th St., Cleveland, remains unchanged.

The Thornley coalometer, for detecting excessive temperatures in piles of stored coal and informing the owner of the condition of his stock of fuel, is manufactured and sold by **F. C. Thornley & Co., Inc.**, whose office is at 31 W. 43rd street, New York. The methods of using the instrument were detailed in the 'Industrial Progress' section of the 'Press' of November 27, 1920.

The Falls Rivet Co., of Kent, Ohio, has just purchased from the Ohio Wire Manufacturing Co. of Akron, all the machinery, patents, and patterns relating to the manufacturing of cotter-pins and flat-spring keys. The machinery has been moved from Akron to Kent and is now in operation. The Ohio Wire Goods Co. will discontinue the manufacturing of these articles. The event marks an era of expansion in the business of the Falls Rivet Co., which will add to its established product of rivets, bolts, and nuts. The cotter-pins in question have two well-known points of merit; the pointed feature which permits the pin to enter the hole readily, and the self-spreading feature. Some users have made a saving of 40% in the time required to insert and open a cotter-pin of the old type.

E. A. Williams Jr., president of the **Garford Motor Truck Co.**, of Lima, Ohio, who has been conspicuous in agitating good-roads issues during the incumbency of President Wilson and the last Congress, expresses the hope that the new order of affairs under Republican control also will include a broad constructive policy of road building. Mr. Williams pointed out that figures available at the Garford general offices show that of approximately 2,000,000 miles of highways in this country, less than one-tenth are improved. "This is a condition that should be remedied," he said. "The business of this nation depends upon its distribution facilities and the success or failure of business lies in the intelligent utilization of these facilities. If business is to expand it must have highway development. A nation can reap more profit from a thoroughly-connected properly-constructed system of good roads than from anything else. It is imperative that we have such a system to handle the constantly increasing need for cheap and efficient transportation of foodstuffs and manufactured articles."

T. A. RICKARD, - - - - Editor

ON February 28 and succeeding six days the Northwest Mining Convention will be in session at Spokane, Washington. This is a regional gathering of mining men, especially of prospectors and small operators in the districts tributary to Spokane. A good program has been arranged by Mr. L. K. Armstrong, chairman of the executive committee.

SECRETARY PAYNE, of the Department of the Interior, has issued a statement concerning the work of the War Minerals Relief Commission. Up to November 27, he says, the Commission had examined 1203 cases and made recommendations in 1124 cases; it had awarded $2,357,491 upon claims aggregating $15,827,479, that is, less than 15%. Evidently the percentage of disappointment will be large.

THE time for doing assessment work on mining locations on account of the year 1920 has been extended until July 1, 1921, in accordance with the bill introduced in the Senate and recommended by the Mines Committee of the House on December 15. This bill was passed on December 20, in preference to pressing the one introduced in the House, which would have dispensed entirely with the performance of assessment work on account of 1920, as was done during the years of the War. It was deemed wise not to press the House bill, to which there was considerable opposition; instead, all the friends of the miner joined in asking for the six-months extension. This has been granted.

AT this season of goodwill it is timely to quote from a letter just received from a Californian mining engineer residing in London and practising his profession there. We asked him to what extent the sentiments evoked by the War have restricted the scope for American mining engineers among British operators abroad. He replies that he has "met with only the best of treatment, most courteous in every respect". He had been elected a director of a company and later he had been appointed consulting engineer, the latter being the more profitable, and more important, appointment, of course. There is no "anti-American feeling" in mining circles in London; indeed, he adds, an Englishman has asked him to enter into partnership with him, and that, he suggests, the other man would not have done if there had been any prejudice against Americans. We mention this to correct an impression to the contrary that seems to obtain among some of our friends in the profession. Whatever little fusses may arise between the newspapers —not the governments—on opposite sides of the Atlantic, and however much pro-German and Sinn Fein propaganda may unite in striving to make trouble between the English-speaking peoples, we are glad to believe, and to know, that the English-speaking mining engineers are comrades all, pleased to work with one another, and willing always to extend the hand of good-fellowship, whether it be done under one or the other of the two flags that have led the way in exploring and developing the mining regions of the world from Cape Nome to Cape Leeuwin, from the Gila to the Vaal, from Chuquicamata to Cusihuiriachic, from Pike's Peak to Mount Morgan.

WORKMEN generally will have to choose between a reduction of wages and a loss of employment, just as their employers generally have to face a decrease in profit or a loss of their market. It is a question of descending the ladder or of having it kicked from underneath. One condition that complicates the general and inevitable effort to meet altered economic conditions is the delay on the part of middlemen and retailers to cut their prices in accord with the reduction made by manufacturers and wholesalers. The cost of living would be scaled down in logical consequence of the recession in wholesale prices if only there were not a tacit conspiracy among retailers to postpone their own compliance with the new conditions of business. Sometimes we wish that a Food Adminstrator still functioned, so that his just but heavy hand might fall upon some of these recalcitrant profiteers, but in default of such a disciplinarian it behooves the press to bring the force of public opinion to bear upon these economic misdemeanants.

FOR several years the Alaska Gold Mines Company has continued to mine and mill gold-bearing rock at Juneau in spite of a considerable operating loss; moreover, it is evident that the enterprise is a failure as a mining venture and that there is no expectation of profitable operations even under improved economic conditions; in fact, an official in New York is quoted recently as explaining the continued running of the plant by the assertion that the company expects to dispose of its power-plant and sundry equipment for use in other industries, the number and diversity of which are con-

stantly increasing in the Territory. The making of paper-pulp is one of them. This statement should serve definitely to establish the status of Alaska Gold; the question arises, if the mine is dead, why is it not abandoned? Because it is cheaper to meet the operating loss than to maintain the equipment after a complete shutdown. Generally when buildings are deserted and machinery is idle, they deteriorate more rapidly than when in use, unless money is continually being spent in caring for and repairing them. The fact that the Alaska Gold Mines Company believes it more economical to operate pending the disposal of its plant offers an interesting side-light on the present dilemma of numerous companies in the United States. Their problem is complicated by sundry other factors. To the producers of copper, zinc, and lead, an argument for suspending operations is that, otherwise, ore-reserves are being depleted, whereas Alaska Gold in reality has no reserves of profitable ore and accordingly can ignore this phase of the question. On the other hand, Alaska Gold has no object in keeping its underground workings in condition for future mining. The current work of maintaining shafts, drifts, and stopes, with the attendant replacement of timbers, is expensive; in a large mine it may amount to hundreds of dollars per day and the work must go on whether ore is being produced or not. Probably the most important reason for continuing to mine in spite of an operating deficit is the desire to keep intact as far as possible the essential parts of the working organization. The wise manager realizes that he has an invaluable asset in a group of men, each of whom is trained to perform a definite part in the delicately adjusted human machine. A good many Western mines working on a curtailed scale seemingly are losing more than Alaska Gold; however, as a matter of fact, they have doubtless calculated as accurately as possible the money value of that intangible asset, their organization, and it apparently has been the determining factor in deciding them to continue production pending an improvement in economic conditions.

FOR the first time in history, gold rather than silver, is wanted in India; that country is actually exporting silver to purchase gold. Sundry events that have a bearing on this condition are discussed in a recent article in 'The Annalist' by Mr. C. C. Latour. In 1893, there was established in India a gold-exchange standard in order to avoid the fluctuation of exchange-rates such as exists in China today. British gold sovereigns and Indian silver rupees were made legal tender in unlimited amount; the ratio of 1:15 was arbitrarily established, that being equivalent to fixing the value of the rupee at 16 pence or 32.44 cents. It should be remembered that it is 'sterling' exchange, not the value of the British sovereign, that fluctuates. When in 1917 the price of silver began to increase, the bullion value of the rupee so far exceeded the exchange-value that the Indian government was compelled, in order to prevent wholesale melting of coins, gradually to increase the official rate of exchange until, toward the end of 1919, the rate stood at 28 pence or 56.77 cents. In order, among other things, to divorce the rupee from depreciated sterling it was decided, after mature consideration, to fix again an arbitrary ratio between the sovereign and the rupee, this time at 1:10, or on the basis of 48.66 cents per rupee. This went into effect at the time when sterling exchange was at its lowest level in New York, and the consequence was a large increase in remittances to London, by means of reverse councils, a form of government draft. The issue of these drafts artificially supported the rate of exchange for the time being, but it could not be continued for the reason that about this time India's export trade began to dwindle; indeed, during recent months Indian imports have exceeded exports, the gross value of imports in August being 300 million rupees as compared with 200 million rupees of exports. This condition was without precedent. India's system of finance, currency, and exchange is exceedingly complicated, and it is no wonder that economists often disagree as to causes and effects. However, India is now exporting silver, whereas a year ago there was an almost insatiable demand for it, the Pittman Act being the direct outcome of this absorption. In the early months of this year India obtained practically all the gold produced in South Africa, because of the fact that the depreciation in sterling in Calcutta was greater than in New York. Now the exchange position of Japan is such that she can draw gold both from the United States and from India. Since October more than $21,000,000 worth of gold bullion has been shipped from India to Japan, this too in spite of the new preference of the Hindoo inhabitants for gold and the consequent demand for it in the bazaars. If this demand becomes great enough, there will be an artificial premium on gold in India that will make shipments unprofitable, despite the existing unfavorable exchange-rate. The discussion is pertinent to our own gold problem in that it demonstrates clearly the fluidity of the world's stock of gold. This is a fact not sufficiently appreciated. International balances of trade and rates of exchange govern the channel and the direction in which gold will flow, and the production of new gold in the United States or elsewhere must be considered only in relation to the entire world's supply.

LITIGATION between Minerals Separation and the Miami Copper Company has been advanced one stage further. On December 9 Judge Woolley in the Circuit Court of Appeals pronounced his decision, on appeal by Minerals Separation from the District Court, affirming the orders of the District Court and holding that the modifications or changes made by the defendant in its milling practice since September 1915 were not plainly mere colorable equivalents of procedures found to infringe. He held further that the practice of issuing supplementary injunctions is not to be adopted in the Third Circuit and that "the remedies against infringement after decree are those which now prevail, namely, damages and profits on accounting, attachment for contempt, and original bill. In the last the patentee's right

to injunctive relief is fully preserved to him". The Court stated: "We have read and carefully studied the entire record. . . . We shall not re-state the law of the case, but shall address ourselves solely to the new facts. These embody at least eleven new procedures or modifications of procedures charged to be infringements because equivalents of the infringements found by this Court in its decree. The processes decreed to be infringements were made up of several steps in which it was found, speaking generally, that infringements were completed before the pulp had reached the Callow cells. In none of the eleven modified processes, again speaking generally, is there a centrifugal pump or a break in the circuit or a pachuca, means or steps held potential in infringements found. In the later modified procedures Callow cells are employed exclusive of and inclusive with other means, in some instances with no prior agitation, in other instances with prior agitation without aeration, in still other instances with prior agitation and aeration, indicating agitation in degrees varying as greatly as the adjectives used in describing it; but whether in any of them there is agitation of the kind, in the degree, and for the duration contemplated by the patent is not so clear and unclouded as to make the newly alleged infringing procedures free from doubt and to warrant the extraordinary remedy of supplementary injunctive relief. . . To avoid the appearance of affirming the Court's decree upon the negative quality of a finding that we discern no error in its order, we go further and say, that, having made the law of the case we are presumed to know what it is, and that, applying the law to the facts, which, in defendant's motion to dismiss are regarded most favorable to the plaintiffs, we would have made the same disposition of the case had we been sitting in the District Court when the application for a supplementary injunction was made. We are of opinion therefore that the order or orders of the District Court should be affirmed and the case be proceeded with expeditiously and in a manner consistent with the law." The accounting is now before a Master, having been referred to him, by order of the District Court, late in 1917. We expect shortly to publish an analysis of the present status of flotation litigation.

A Yankee Engineer

Among the pine-clad slopes of the Sierra Nevada, on the Pacific side and overlooking the central valley of California, is a pretty settlement called Grass Valley. It is a community devoted to gold mining and is distinguished among other Californian mining centres as the locality where was started the first digging into hard rock for gold-bearing quartz in veins or lodes, following the early washing of the gravel in the river-beds from which the miners of '49 drew their riches. In 1851 the first shaft was sunk on Massachusetts hill; now the Empire mine has a vertical depth of 2705 feet and the North Star is 2500 feet deep; but these figures fail to measure the extent of the mining operations, because the North Star shaft, for example, follows the dip of a flat vein so that it is 6300 feet long from top to bottom, where, by the way, it is just a hundred feet below sea-level. The North Star has had its vicissitudes, like most mines, but it has been yielding gold almost continuously for 25 years. Moreover, it has been a mining school to a number of engineers now playing a useful part in the world. Originally it was an undertaking launched by that fine old gentleman, James D. Hague, and it was opened up under the technical direction of another engineer of the old school, the school of scholars and gentlemen. We publish an interview with the veteran manager, Mr. Arthur DeW. Foote, now partly retired and succeeded by his son. The story of the big men connected with the big mines is more interesting, we venture to suggest, than the statistics of production or than even the evolution of technical processes. Mr. Foote is a representative American, in his ancestry, his early environment, his schooling, and the venturesome beginnings of his professional career. The interview shows that he is direct and outspoken, eschewing periphrasis. He speaks of men as he found them, and he had to deal with many kinds, but in all his dealings he asserted the essential manhood and self-respect that we like to consider peculiarly American. He could look any man in the face, and, if necessary, tell him to go to hell; but he did not say it too often, and he never said it without cause. He was always kindly and polite to those with whom he worked, either as subordinate or chief. Mr. William Hood, the veteran railroad engineer, to whom Mr. Foote was assistant 45 years ago, tells us that he was "exceedingly competent in his work and a most agreeable gentleman, with whom it was a pleasure and privilege to be associated". Another veteran engineer, Mr. Edward A. Rix, says that Mr. Foote impressed him always as "singularly fair and just in his dealings". He is a civil mining engineer in a double sense; beginning with tunnel and railroad work, he turned to hydraulic engineering on a large scale and then drifted into mining and metallurgy. His early training made him keen in the selection of the machinery employed in mining and more particularly the use of compressed air, for pumping and hoisting, as well as drilling. In this branch of mechanical engineering he was a pioneer, and, as the interview records, he found keen pleasure in planning and devising (with Mr. Rix, a specialist) new types of compressed-air machines, which were then, 25 years ago, in their infancy of development. He had the courage of his convictions, reinforced by a thorough knowledge of the principles involved. For example, the ordering of the 18-ft. direct-connected Pelton waterwheel, which actuated the first compressor at the North Star, required some nerve, for it was of much larger diameter than any previously constructed and was built with spokes in tension like a bicycle-wheel. Mr. Rix says: "The usual knockers lined the fences to see her blow up when started, but they were disappointed." Mr. Foote has decided ideas on education, more particularly the need for teaching English to engineering students. He becomes explosive in talking of the jargon that is the accepted medium of literary communication among members of the profession. He has an understanding sympathy for the toilers underground and recognizes that

the entire morale of a working force depends upon the personality of the manager, superintendent, and foreman. He places his finger on *the* weak spot of industrial management, namely, the increase in the size of the operations and the number of men employed to such an extent that personal influence becomes extinguished and the relation of a manager toward his employees becomes dehumanized. That is repellant to him, for his traditions and his education alike have given him a feeling of keen responsibility to the men whose work he directs and an appreciation of their troubles and distempers. He is like the type of Colonel who is a father to his regiment. Which reminds us that he appears disguised by literary art in a book called 'The Ground Swell', written by his wife, who, as Mary Hallock Foote, is known to many of our readers as the author of 'The Led Horse Claim', 'The Valley Road', 'The Chosen Valley', and a number of other books in which the refined imagination and the tender feeling of a New England gentlewoman give charm and reality to divers phases of Western life. In the retired General of 'The Ground Swell' we catch glimpses of our mining engineer at Grass Valley. "When he's happy he drops into Uncle Remus talk; when he is very happy he becomes nautical. In his far-off boyhood he had played with boats." Again: "My husband could do foolish things with money, but he had a long-distance wisdom at times that money cannot buy." When things did not go quite right he would describe them humorously, "not being a bitter person". As for example, in his disagreement with Adolf Sutro. It is a great help to one's philosophy of life to be able to see a joke against oneself; indeed it is the supreme test of humor. Looking at Mr. Foote's career as a whole, it may be remarked that a good training in any branch of engineering is a preparation for any other branch of the profession; undoubtedly mining engineering benefits from the incursion of ideas brought to it by competent civil engineers, and there is something in Mr. Foote's remark that the civil engineer or the hydraulic engineer has "a broader education and a broader scope" than the mining engineer; in short, much that the members of our profession are called upon to do is only slightly related to their technical training, but, for that reason, there is more opportunity, we believe, for the play of personal character in mining than in other phases of "the art of directing the great sources of power in Nature for the use and convenience of man". In the exercise of that art it is necessary not only to direct natural sources of power but to direct the energies of human beings, and therein lies its chief interest, difficulty, and importance. Modern industry has developed an ugly aspect, largely because, with all the improvements in mechanics and chemistry, we have not produced a sufficient number of men competent in character to be given the charge of large numbers of their fellow-men. That is the main problem facing our industrial democracy. We need more engineers like Mr. Foote, alert and sagacious, but also humane and sympathetic to those who work *with* him rather than *for* him; in short, the democratic ideal of industry is not serfdom but co-operation.

Immigration

Restriction of immigration is the subject of Congressional legislation just now. In the annual report issued a few days ago by the Department of Labor will be found a set of statistics that are worthy of study. During the last fiscal year, 633,371 aliens arrived in this country, as compared with 237,021 the year before, but 428,062 departed, reducing the net increase to 193,514. This is a much smaller figure than had been anticipated from periodic statements on the subject. Before the War the annual increase due to immigration was about four times as large. In 1914, immigrant aliens numbered 1,218,480 and emigrant aliens 303,338. Of the 2762 ordered deported during the year, 469 were classed as anarchists and criminals. Of the total arrivals 11,795 were sent back. During the past fiscal year 16,174 Japanese arrived and 15,653 departed, leaving 521 as the net increase. It would be well if Federal officials compared their statistical statements and thereby inspire greater confidence in them. For instance, Mr. Anthony Caminetti, Commissioner General of Immigration, says that last year Japanese immigration increased 13%, but he does not say whether that was a net increase. He mentions the interesting fact that there was a net increase of 82,357 from Canada and a net increase of 45,755 from Mexico, these two items making together 66% of the total net gain in our immigrant population. During the year, 519,003 aliens took out either their first or their final papers of naturalization; first papers were filed by 300,106 aliens, while final naturalization was claimed by 166,925 aliens in civil life and 51,972 soldiers. Mr. William B. Wilson, the Secretary for Labor, suggests the establishment of Federal agencies overseas, in co-operation with foreign governments, for the giving of information to expectant emigrants in order that they may know the restrictions to which they will be subject and the conditions that they will face on arrival here, thereby presumably checking the attempt of those who are inadmissible or otherwise unwelcome to our shores. It is obvious, from the official statistics, that the influx of aliens is much smaller than was generally supposed; it is considerably less than is required by the normal expansion of industry in this country. We are informed that there is a considerable influx of Russian Jews of the small-trader class, and also of Italians. The latter make good citizens, especially if they come from northern Italy, but the Russian-Jew peddler type is most undesirable, because he is non-productive, becoming merely a minor middleman, and bringing with him notions of living and of government that are intensely foreign to the American idea. If the attempts to restrict immigration are intelligent, in excluding undesirables, not on account of poverty or race, if white, but on account of incompatability with our American ideas of life and government, they deserve to be supported; if they are meant merely to strengthen the control of organized labor in this country, they deserve to be opposed, as probably they will, by our representatives in Congress. We hope the bill now before Congress will fail to pass.

THE NORTH STAR MINE AND MILL

Arthur DeWint Foote, of Grass Valley

An Interview, by T. A. Rickard

Mr. Foote, you come of old American stock?

Yes, for eight generations; my ancestors came from Yorkshire in 1630.

Where were you born?

At Guilford, Connecticut, in 1849.

Was your father interested in mining?

No, my people were farmers and soldiers for generations.

That explains your interest in irrigation, and in engineering as applied to the improvement of farms.

I suppose it does; I was interested as a boy in a drainage scheme we had at home.

What was your early education?

Private school and high-school and a short time at the Sheffield Scientific School at Yale in the class of '69, which I left in 1868. My eyes gave out, so I had to stop studying. Then I went to Florida to grow oranges. After a year or two I went back to New York and got my eyes back. The next winter I was in the West Indies. Then I returned to New York and worked in the Atlantic Dock iron-works, in Brooklyn. Later, I was over a year at Washington, laying asphaltum pavements. During this time I was studying more or less on engineering lines. In the fall of 1873 I came to San Francisco.

What brought you here?

I was looking for something to do, and at that time San Francisco was lively.

Did you get a job soon?

Yes; I went up to Virginia City, Nevada, as assistant engineer on the Sutro tunnel.

Under Adolf Sutro?

Yes. Wederkind was chief engineer. He was a Dane who had run the lines for the Hoosac tunnel and came out to the Sutro tunnel as engineer several months after I got there.

Do you recall your impressions of the Comstock and Virginia City?

I had a letter of introduction from James D. Hague to Isaac Requa, the father of Mark L. Requa. He was very civil to me and showed me around. I remember being much impressed by the Cornish pump in the old Chollar-Potosi shaft. I met Ross E. Browne there at that time.

Which impressed you most, Ross Browne or the Cornish pump?

I think Mr. Browne made the most lasting impression. He worked with me on the tunnel some of the time before Wederkind came out. He has been a good friend of mine ever since. I left there in 1874. Sutro fired me. We had struck a flood of water in shaft No. 2 of the tunnel and were drowned out.

Why were your drowned out?

We had to run the pumps so fast that the steam-pipe heated the shaft until it became impossible for men to work. Sutro came to the office, fuming and swearing,

whereupon I told him that we had not been 'drowned out' but we had been 'burned out'. He did not like it, so we parted company. I did not then know that he had put in the steam-pumps against the advice of everybody who understood the subject, because he could buy them for stock in the tunnel company. At that time the only kind of pump that would have served our purpose was the Cornish pump. Today, of course, under similar circumstances, we would use electric pumps. It might be worth while, as a matter of record, to mention that while at the tunnel I helped J. B. Pitchford, who was master mechanic, put up the first air-compressor installed in the West. In fact, there had been but two in the whole country before that: one at the Hoosac tunnel and one at a Delaware & Lackawanna railroad tunnel.

What did you do next?

I went up on the Eldorado canal under F. A. Bishop, on the south fork of the American river. It supplied water to the hydraulic mines around Placerville. I remained there only a matter of eight months. Then I went down on the Southern Pacific railroad to Tehachapi, where I was under William Hood, chief engineer of the Southern Pacific. He was very kind to me and we have been friends ever since. I got tired of the desert country and got back to underground work at New Almaden.

Who was in charge of the New Almaden at that time?

J. B. Randol.

Who was in charge of the engineering staff?

No one but myself. Hamilton Smith came down to look over my work on a difficult piece of surveying, and thereby I became pleasantly acquainted with him, and through him with Henry C. Perkins. I stayed there some three years, and while there, in 1876, I was married to Mary Hallock.

Did you live in the old 'casa'?

No, we lived on the hill; I fixed up a little cabin there. Both of us enjoyed it. My work was absorbing; some of it was quite difficult, and the Mexican element was extremely interesting to my wife. Our son was born there. He is now general manager of the North Star mines, at Grass Valley.

Why did you leave?

Randol and I did not agree.

On technical matters?

No, on general principles. I resigned and went up to Deadwood, South Dakota, where I worked as engineer under Sam McMaster, superintendent of the Homestake. I opened an office on my own account, but most of my work was done for the Homestake Mining Company. The owner, George Hearst, who was in partnership with Haggin and Tevis, was living there at that time.

Was Hearst a good miner?

His principal business was lawsuits. He always claimed he did not know anything about mining, and refused to act on his own judgment. He said, if he went to a dump he would be sure to pick up the only piece of good ore that was on it. He employed Henry Janin, Louis Janin, and James D. Hague. He himself was dirty, slovenly, and extremely vulgar.

Was there anything in your work at the Homestake of special technical interest?

Well, there was only one point of particular technical interest; that was whether the Homestake and the Old Abe veins came together in depth; but the mines were not opened sufficiently to warrant an opinion. It was thought finally that they would come together, so Hearst bought out the other parties, after trying to beat them in a lawsuit. I was not sorry to leave Deadwood, in '78, to go to Leadville.

Yes, I know you were at Leadville, because I read 'The Led Horse Claim', Mrs. Foote's book, about 35 years ago, and I still recall the charm of it. What took you to Leadville?

My first job was on the Iron Silver suit, as an expert. That used up several months. I established an office there and was afterward in charge of the Adelaide and several other small mines.

What was the mine that figures in 'The Led Horse Claim'? As I recall, the story dealt wath a lawsuit and trespassing that culminated in fighting underground at the boundaries of two conflicting mining properties.

The foundation of the story was the suit between the Adelaide and the Argentine.

It is generally supposed that the hero was typified by Ferdinand Van Zant.

No, he was a friend of ours and he was my clerk at that time, but a great many incidents in the story were imaginary. It was a picturesque case. When the fellows on the other side broke through below, they drove our men out. Steve Fleming grabbed his Winchester, threw his leg around the rope—a wire rope—and went down, hand over hand. He got to the bottom and ordered them out. They could not see him, of course, but they could hear the click of his rifle—not to mention the language that he used, suitable to the occasion—they went.

Who, among mining engineers, were at Leadville at that time?

Most of them used to come around to us: Clarence King, Rossiter Raymond, S. F. Emmons, James D. Hague, R. E. Booraem, R. W. Emmerson, and many others. Tom Walsh, of Camp Bird fame, was keeping a hotel in Leadville. When I first arrived, I could not get a room, so he took me in most kindly. I had known him at Deadwood.

Was he a carpenter at Deadwood?

No, I think he kept a restaurant there. It was a very pleasant summer in many ways, because Emmons had his camp near our cabin on the outskirts of the town, and we used to have delightful meetings with him and Clarence King, Hague, Raymond, and other men of high character, coming and going. Dr. Raymond wrote a poem on the cabin and sent it back to us. I remember

CANAL OF THE IDAHO MINING & IRRIGATION CO.

twenty years afterward going to his office in New York, and as soon as he saw me enter the room he started to quote this poem of his, 'The Little Log Cabin by the Ditch'.

Can you mention some technical recollections?

Yes, I would mention the fact that at this time James B. Grant, afterward of the Omaha & Grant Smelting Company, and Governor of Colorado, did the first direct smelting of galena without roasting in a blast-furnace—a water-jacketed furnace. Those of us who were in Leadville at that time took a keen interest in the experiment.

How long were you at Leadville?

I was there over two years. Mrs. Foote enjoyed it more than I did, because it was such a contrast to her previous life on the Hudson river and in New York City. She began to write while at Leadville, and her first story was the one that you have already mentioned. It encouraged her to keep on. Before that she had been an illustrator for magazines in New York. My health broke down, owing to the high altitude, which affected my nerves, and I went East for a while. That winter I went to Mexico and stayed down there for several months.

Where?

For a time I was at Morelia in the State of Michoacan. The trip did me lots of good, and on my return I went into the Wood River country, Idaho.

What mines?

I examined several mines, and finally opened up a prospect called the Wolftone.

Did you name it after the mine at Leadville?

No, it was probably named after the Irish leader. I stayed there until the beginning of the next winter, and while there I became interested in an irrigation project on the Boisé river in the Snake River valley. The land lies between the Boisé and the Snake, forming a peninsula. I took up water-rights on the Boisé river and made the surveys for a canal to serve some 300,000 acres of land.

On your own account?

I was doing it on behalf of myself and some friends. We organized a company later and called it the Idaho Mining & Irrigation Company. My habits as a miner led me to prospect the bars on the Snake river and to add the word 'mining' to the name of our company.

Did you find anything?

Yes, I found a large area of ground that would pan from 50 cents to a dollar per yard. Eventually, when we got a small canal built and the water on the ground, we washed it as they do on the Snake river, by means of sluices, screens, and blankets. Our blankets we washed in a tub. That was my first experience with cyanide. We put a little cyanide into the tub to brighten the gold, and it immediately dissolved most of the gold, which was very fine and very pure. The clean-ups were disappointing. We did not work long. That was just a year or two before the discovery made by MacArthur and Forrest.

But if the gravel contained from 50 cents to a dollar per yard, surely it will pay to work today?

I presume it would; but at that time we gave our chief attention to the irrigation work. I was there some twelve years and had great difficulty in getting money to build the canal, but finally built a portion of it. Our directors had trouble among themselves, and the enterprise was abandoned. The canal has since been built by the Government. There was never much publicity about it, though it is the largest irrigation canal in America or Europe, having a capacity of over 4000 cubic feet per second; and the Arrow Rock dam, which forms a huge storage reservoir for it, is the highest dam in the world. During that time I was engaged for a couple of years or more on Government work—the first Government irrigation survey in the United States. I had charge of the Snake River division under Major Powell, director of the

U. S. Geological Survey. Those years were extremely interesting with two or three parties running canal-lines on the Snake River desert, preliminary surveys for the irrigation of several million acres, hunting the Grand Teton range for reservoir sites on both forks of the Snake river, through Jackson's Hole, up to the Yellowstone and Henry's lakes.

So then you had to abandon this Boisé project, and you returned to mining?

Mining or quarrying. In 1893 I went to Lower California to open up an onyx deposit, in which Emmons was much interested. In fact, I went down there with him. There was a big mass there of the most beautiful rock you can imagine, but it was 75 miles from the coast. I built the wagon-roads and arranged for putting the material on board ship. Then the panic came on and the enterprise was abandoned. From there, I came up to San Diego, and Hague telegraphed to me to come to Grass Valley. On my arrival he told me of some of his plans for the North Star mine. He told me that he was going to open up the Rocky Bar mine on Massachusetts hill—I mean the one in which the Watts made their money. It was rumored that there was a good deal of water to be encountered, and Hague wanted me to go and see what few electric plants there were then in the West, so I went to the Fremont mine at Amador City and saw their electric pumping equipment. I was to have gone to Bodie, but I did not go. It was just after the Bodie electric line had been completed. But I went to the Calumet & Hecla in Michigan. They had just put in two sets of pumps having a 1600-ft. lift each. I stayed there for a week and learned all I could about them. In January 1895 I came to Grass Valley to open up the group of mines for Hague, who represented what is now the North Star Mines Company.

This company has an interesting proprietary.

Yes, we had a fine lot of shareholders. The Agnews and Blisses of New York, the Phelps Dodge people, including James Douglas. J. P. Morgan was one of the stockholders, also Balfour & Guthrie. Hague himself had a large interest.

The first time that I visited the North Star mine, Emile Rector Abadie was the superintendent. That must have been in 1886, because I remember being interested in comparing the methods of milling with those used in Gilpin county, Colorado. The next time I was at Grass Valley was on the eve of George Starr's departure from the Empire mine to go to South Africa. That was in 1893. I remember that my first meeting with you was on my return from Australia in 1898, when, like most intelligent mining engineers, I took the opportunity to visit Grass Valley, more particularly the North Star mine. You must have had an enormous number of visitors during your residence at Grass Valley.

Yes, it has been a great deal of pleasure to us to have

[illegible]

North Star mine, more particularly with reference to its vicissitudes and its success?

I did not agree with Hague about using electric power for pumping. The mechanical application of the power was not sufficiently developed to constitute good engineering; so I put in a compressed-air plant to do our pumping, hoisting, and drilling.

What sort of a plant did you erect?

We were getting our power from water. We bought water, delivered to us at the top of the hill over 2½ miles away, and we let that water down in a pipe to the lowest point of our land and applied it to Pelton water-wheels. Our ditch gave us an 800-ft. head of water, and that, by the use of large water-wheels, enabled us to employ direct-acting compressors.

Of what make were they?

The first two were designed by Edward A. Rix of San Francisco and were very successful. Later we put in two others of our own design.

How long did it take to unwater the old mine?

The mine did not make a great amount of water: four to five hundred gallons a minute. It took us about four months, after we started the pumps, to get to the bottom. That was late in 1896.

Then you began to explore the old workings and open up new ground? Were you put in charge?

After I got the machinery all in, I was appointed superintendent. That was in June 1896. We began sinking, and found that the old shaft was vertical for about 240 ft.; then it went off askew at a flat angle.

So that it was not usable?

Well, I made it work by putting in a vertical curve, as well as a horizontal curve to get into the old incline and then I was obliged to put another horizontal curve into that shaft to get down at right-angles to the vein. It was about as straight as a dog's hind leg. We found a nice body of ore on the 1300 level. We also found a good body of ore up above where the Watts had taken out their bonanza.

What level?

That was above the old workings, probably 200 to 250 ft. from the surface. As we went down, the vein became larger but very poor, and it continued to flatten, so that the conditions became most discouraging. We stopped and abandoned the mine.

That was in?

In 1899.

Had you made any profit over the cost of equipment?

Yes, we had taken out enough to pay for all our trouble and a little more. We took out about $800,000 worth of gold. In the meantime we started a new vertical shaft to tap the North Star vein at the forty level—that is, as measured on the dip of the vein. The shaft cut the vein at 1600 ft. below the surface in April 1902.

Did you find good ore?

Yes; we found, right at the bottom of the shaft, a

bunch of fair ore. The quartz from the first blast, as it came up, showed little bits of gold in almost every piece. It probably assayed about $20—an ounce—per ton. Then we cut our station and commenced drifting and put up a raise to reach the bottom of the old shaft. Of course, we encountered a great deal of water. In driving at the 40 level and putting up this raise we often had to plug up the holes to keep the water from drowning the pumps.

But I presume that the pressure was greatly relaxed as the water-plane was lowered?

I presume so. After a year or so this flow of water almost ceased. We extended the 40th level, and then the 37th, and then others in succession. The 37th was the richest level in the mine.

By "rich" what do you mean in terms of feet and dollars?

There was over 2000 ft. on that level that would average $15 for a width of 2½ ft. in the mill. Near the shaft there was one bunch from which we took out $16,000 from ore that was so rich that none of it went to the mill. We crushed it up in the assay-office and put it into the crucible to be melted. It was great stuff, I tell you.

The mine has had no set-back since then?

Not until the War raised the prices of everything that we had to buy, and did not raise the price of our product, namely, the gold.

What has been the output of the North Star since you have been connected with it?

I will have to refer to the records for that. They show about 1,600,000 tons averaging $11.35 per ton, making a gross value of $18,000,000, from which about five millions have been paid in dividends.

How is the bottom of the mine?

On the 6300 level the North Star meets what we call the 'X' vein, that is to say, a vein coming down from the east at a dip of about 40 degrees. Whether the North Star vein goes through, we don't know yet. Apparently it does not on the south side of the shaft. Meanwhile, the 'X' vein is going down strongly, dipping west, and shows a good width of milling ore scattered in a wide lode.

What is the vertical depth of the 6300-ft. level?

The dip averages 24°, so that level is 2500 ft. below the surface or 100 ft. below sea-level.

Are you doing any work below the 6300?

No. When we shut-down last winter, we stopped all the work on the 63, and now are doing development work and a little stoping on what we call the 'A' vein on the 34, 40, and 47 levels. This 'A' vein connects with the North Star vein between the 40 and 47 levels.

You say that you shut-down last winter. Why?

The mine was not paying owing to the fact that about one-third of the men would not do a fair day's work and would not allow the others to do so. Therefore, we discharged 250 men, retaining 110, doing just stoping enough to pay our overhead expenses and taxes, and a large amount of development work on the 'A' vein. These 110 men are doing more than two-thirds of the work done previously by the crew of 360.

The men that you have retained, I presume, have homes in Grass Valley?

Yes; they are old men who have been with us for years. They are mostly the sons of Cornishmen who came to Grass Valley in the early days. All the old fellows are pretty well gone.

What do you think of the proposal to levy a tax on manufactured gold under the McFadden Bill? Do you think it will help gold mining in California?

I think it might help gold mining, but I object to it as being special legislation and thus giving an excuse for other special legislation that would injure us about as much as the proposed law might help us.

Are you using flotation in your mill?

No. We made a pretty careful investigation to ascertain if it would be advantageous to us, but we found that the amount we might save would be very nearly eaten up by the royalty and would require a considerable investment. It was a question whether the profit would be sufficient to pay for the investment. The terms of the contract we could get from the Minerals Separation Company disgusted us so much that we told them to go to hell.

Mr. Foote, your son has followed in your footsteps?

Yes; he graduated as civil engineer from the 'Tech.' at Boston in '99 and came as my assistant at the mine in 1904. In 1912 we made him general superintendent, and in 1915 he was made general manager. Meanwhile, I was semi-retired as consulting engineer for the company.

By the way, you had an interesting experience in the Tightner mine, did you not?

We had an experience that was delightful for a time. It was rather interesting. Driving north on the vein, we struck a bunch of quartz about 30 ft. wide and perhaps 100 ft. long. We stoped up on the foot-wall, getting indications of gold; in fact, we milled about 5000 tons, which went $2.49 per ton. Then, in putting up a raise from the stope, we ran into coarse gold, and worked to the hanging over the former stope of poor quartz, taking out $750,000 in gold in a space less than 100 ft. square. Some of it was so rich that we had to cut it up with chisels to get it to the mill.

Did you send it to a stamp-mill?

Yes, we put it under the stamps in order to remove the barren quartz, and then milled it.

That is, you used the stamp-mill as a crusher and not as an amalgamator?

Exactly.

I presume that the so-called barren quartz was good enough to be re-treated?

It went right on over the amalgamating-plates in the regular way.

Well, that must have been delightful, but did it happen again?

Not in such a large amount, but we found numerous

bodies that yielded from $75,000 to $100,000 in the course of three years.

Did this gold occur above the water-level, or the limit of oxidation?

That is pretty hard to answer, because the apex of the vein is covered by 1000 ft. of lava. The Middle Yuba river near-by is at a level 2000 ft. below the horizon at which we found this gold.

Did you find the outcrop of the vein in the bedrock of the old alluvial channel?

That was where the old miners discovered it and told H. L. Johnson about it, and he opened the old tunnel and found it. That was the origin of the Tightner mine.

How much has the Tightner produced?

Under our management, it has produced about $1,700,000, and about $400,000 more for others.

Do you consider mining engineering a good profession for the young men of this generation?

Yes, it is a fine occupation. The mining engineer's life is as interesting as that of a civil engineer, and there is probably more money in it, but the civil engineer or the railroad engineer or the hydraulic engineer has a broader education and a broader scope than the mining engineer.

Have you any suggestion for improving mining education?

Professional education, I suppose you mean. Prof. Christy used to ask me that question and when I suggested reading and writing he seemed disappointed until I explained that by 'reading' I meant reading good literature, historical mining, and geology until the student acquired something of a vocabulary and the proper forms of language, and by 'writing' I meant a cultivated handwriting, and using words intelligently so as to convey ideas clearly with fine distinctions. When a man can do that he has advanced far in his profession.

Have you any particular ideas for the betterment of industrial relations, that is to say, for improving the relations of employer to employee in mining enterprises?

My idea is that the personal equation is everything. The great difficulty is that when you get a large number of men under one management you obliterate that personal equation and so render the relations unhuman. I think the remedy is coming by means of the shop committees, as they call them in England, or grievance committees—an unfortunate name—more properly welfare committees, composed of one man from each gang of workmen to meet with a special representative of the management freely and without prejudice at any and all times. Any serious matter that cannot be arranged by him is brought to the superintendent, and if not then fixed up, is brought before a Board of Conciliation composed of employees and officers in a proper proportion. This welfare man must have the special talent for spreading his personal equation of kindliness and reasonableness through all the working force. This man will be difficult to find, but the position is next in importance to that of the manager and should be treated accordingly.

What do you think about the proposed Department of Public Works to include all the engineering functions of the Federal government?

I think such a Department would save millions of dollars every year and get more, much more, useful work done than is done now. Such a Department organized by and under the direction of Herbert Hoover, taking the place of the Interior Department, would prove so economical and efficient that soon the people would be demanding that all engineering work should be done under it.

What do you consider the prospects of further gold discoveries in the United States?

If you mean absolutely new discoveries, like Cripple Creek, I imagine few are to be made. If you mean new discoveries in small mines and prospect-holes now lying idle or being held by annual assessment work, I think there are great numbers to be made. When gold again reaches its normal value, gold mining will revive and our production will increase and continue for many years beyond our ken. It probably will not be as spectacular as in the past, neither will it be as uncertain. Much has been learned about gold mining, even in the last 25 years, and it seems to me that the future mining will become more and more a manufacturing business managed by trained men, who will take only reasonable risks and will be satisfied with reasonable profits.

What do you consider the most satisfactory experience of your career?

That is a somewhat difficult question. Probably my twenty-odd years at the North Star mine have been the most satisfactory. There were several quite interesting engineering problems to work out: a good hard fight at times, when men had to be held to their work with moral suasion and profanity properly blended. There were times of discouragement, of course. I remember Hague saying to me very pleasantly, "Do you know, Arthur, you have spent over a million dollars since giving us a cent". Mr. Hague was a most delightful man to work for. His sense of humor would dominate any occasion and cover all trouble. He never bothered me with details. His only specification for a stamp-mill that was to cost $80,000 was, "Build it to last thirty years". So I built the mill of stone and iron, and it was satisfactory. Hague died in 1908, just at the beginning of our reward for ten long years of preparation. That year the mine produced over a million dollars and continued at that rate until war prices shut us down. After James D. Hague died, his son William, or 'Billy' as everyone called him, came out as managing director. He built a house and brought his charming wife out, and his children were born here. As I had turned over the active charge of the properties to my son, I had the pleasure of watching the second generation carrying on the work of their fathers until the War came. Yes. I think I may say that the years from 1895 to 1916 were the most satisfactory or the least unsatisfactory of my life.

Methods of Ore-Sampling in Montana—II

By H. B. Pulsifer

METHODS OF SAMPLING. Methods for sampling may be divided into those carried out by hand and those done by power on a larger scale, commonly called mechanical. The hand methods are mainly cone-and-quarter, fifth-and-tenth shovel, split-shovel, pipe-sampling, and riffle-sampling. Mechanical samplers cut out the sample by some device like a slot, or blade, which separates the stream of ore as it falls past the rotating, oscillating, or vibrating part of the mechanism. The ultimate analysis of nearly all mechanical cutters reveals them as of the intersecting cone, or saucer type. From another angle they can be regarded as the hand-riffle rotating about a vertical axis and with the number of slots reduced to only two, four, or eight.

From the theoretical point of view, all the methods of sampling are mere applications of the probability principle. At one extreme, a lot of substance may be thoroughly mixed, after which any one small selection will correctly represent the original lot; the other extreme is presented by material that is heterogeneous, but by taking enough cuttings, often thousands, the sample will represent the entire lot. In practical work we commonly use the extreme methods or a suitable intermediate process. Cone-and-quarter sampling involves thorough mixing and a limited number of cuts, to which is added an attempt at diagonal compensation afforded by a spread cone; as a working method it is now generally replaced by the use of the stand and table slotted cutters. The riffle-cutter will mix a sample, or divide a sample, with a facility never approached by cone-and-quarter work. Pipe-sampling is probability sampling depending upon from 30 to 100 cuts, on comparatively uniform material.

In the Montana bulletin I described the practice of pipe-sampling at Butte in the following paragraphs.

"PIPE-SAMPLING. Pipe-samplers have long been used in Montana and in other sections of the country, notably at the zinc mines in Missouri and Oklahoma, where the cars of concentrate are sampled with a 'gun', as the pipe-sampler is there called, immediately after loading for the smelters. Since the advent of flotation concentrates, which are notoriously sticky and difficult to handle, the use of pipe-samplers has increased greatly in the Butte district.

Ore suitable for pipe-sampling may be concentrate or other fine material that has been produced in a regular and uniform manner, or has been mixed in handling. Flotation concentrates may vary in moisture from a thin mud to a dry powder. When sampling carloads of the muddy concentrate men are sometimes barely able to stand on the drying crust. Cars that have traveled long distances may have the load so firmly packed that an auger, rather than a pipe, is required to cut the samples.

"According to the Montana practice, lots of concentrate are sampled at the mill by the shipper and later at the custom sampling-plant, or smelter. Data as to agreement of assays are not available, but results are said to be wholly satisfactory.

"Pipe-sampling of a carload of concentrate usually begins at one end of the car, where a row of holes two feet apart and two feet from the end-wall is made; a parallel row is then punched two feet nearer the centre and this is repeated until samples are taken systematically over the entire length of the car from points about two feet apart. Hopper-bottomed cars have the two deep pits, which are hard to penetrate, but the pipes are long enough to touch the steel bottoms, as in the shallower portions of the car.

"Pipes are commonly four to five feet long, three inches diameter at the top and two inches at the cutting edge. For firm materials, easily cleared, circular tubes are used; for sticky loads the pipe is slotted and provided with a scraper with which the sample-man quickly forces the core out into the sample-pan. A sample of 250 lb. is usually obtained by from 40 to 75 insertions of the pipe. Fig. 7 shows three men sampling a car of flotation concentrate at the Washoe sampler.

"Pipe-sampling of fine concentrate may continue in the bucking-room until the final samples for moisture and assay are taken. The sample-man merely goes over the pans containing the first sample with a smaller pipe, a foot long and an inch in diameter, and punches enough cores to give a sample of the required weight.

"The accuracy of pipe-sampling clearly depends on the uniformity of the lot of ore as it is spread in the bin or car. To test the uniformity of concentrate in a railroad car, the author took 40 four-ounce grab-samples from the pipes as a car of flotation concentrate was being sampled at a custom-plant. Each of the samples was dried, ground, mixed, and analyzed for iron with the following results:

Sample	Iron, %	Sample	Iron, %
1	14.7	21	13.4
2	14.2	22	15.5
3	13.8	23	13.1
4	14.5	24	13.1
5	14.0	25	13.1
6	14.2	26	18.3
7	14.3	27	13.8
8	14.1	28	14.5
9	15.0	29	14.8
10	13.0	30	15.0
11	14.1	31	14.8
12	14.8	32	16.2
13	14.5	33	15.7
14	13.8	34	16.3
15	14.5	35	17.2
16	14.1	36	15.4
17	13.2	37	14.8
18	13.6	38	15.3
19	12.8	39	17.4
20	15.0	40	14.3

"The average of all is 14.7%, and the average devia-

tion of a single analysis is only 0.9% from 14.7%. In other words, the average deviation from the mean is approximately one part in fifteen. From the sampling point of view it means that one could take a grab-sample anywhere in the car and the probable analysis of that sample would be accurate to closer than one part in fifteen.

"The main pipe-samples, from which the little samples just discussed were taken, weighed 25 to 30 times as much and were piled and again piped before drying, mixing, and grinding for the regular sample. The main sampling work might reasonably be expected to be 10 times as accurate as the author's grab-sampling, which would make the main pipe sampling accurate to more than one part in 150, a precision considerably greater than ordinary assaying or wet chemical analysis.

"Pipe-sampling of fine mixed materials is rapid and cheap; the test confirms the prevalent opinion that it is also accurate."

The use of the stand-riffle as an instrument for mixing and cutting samples is justified by the large number of cuts which can be made with slight effort. Thousands of cuts are made when fine ore or pulp is shaken across the top of the row of riffles; every condition thus favors the free play of the law of probability, namely, that the greater the number of cuts the more nearly the composition of the sample will approach the composition of the entire lot. In the Montana bulletin the subject of riffles was discussed under the heading of 'Mixing the Sample'.

"The mixing of a large lot of ore consisting of large and small pieces is almost impossible and, besides, is wholly useless. When you try to do this you find that any method of handling assorted sizes allows segregation if the material is dropped, or let roll, or even moved by ordinary implements. The material cannot be properly sampled by small selections of single pieces, because the larger pieces exceed the proportionate composition in all components.

"The mixing of large lots of fine ore or mill-products is not as difficult an operation as the preceding, but is seldom practicable unless done incidentally in the production or transfer of the material. Even if a lot of fine ore appears to be uniformly mixed there is no easy demonstration of the fact, and it is much safer to depend on a considerable number of cuttings. The frequent division of a fairly uniform material is carried out in practice when mill-streams are sampled, either mechanically or by hand, when cars and bins of concentrate are pipe-sampled, and in shovel-sampling by the tenth or fifth shovel method. The three methods last mentioned are really applications of probability sampling where the material is known to be nearly uniform, and where from 50 to 500 selections suffice to establish the required precision in the sample.

"A thorough mixing of the final portion of pulp previous to its division into several samples to be placed in separate packets is indispensable. A large number of rollings on a suitable cloth or paper is the almost universal way to do the final mixing. Rolling, when skillfully done, accomplishes the purpose, but the great objection to rolling is that it is tedious and requires both time and patience. If cloth is used it may well have a pebble-grained surface; a paper should have a matte surface. The surface of either cloth or paper is commonly colored black to show the sample more clearly.

"Substitutes for rolling the pulp on cloth or paper have been proposed; the Anaconda sample-mills use cube-mixers and at the School of Mines a small table-riffle answers the purpose. At Anaconda both mills are equipped with eight-inch cube-mixers which are rotated by power slowly enough for the contents to undergo practically the same sort of tumbling which a pulp gets when rolled on a sheet. Cube-mixers have not proved satisfactory in all plants and their use in the State is limited to the Anaconda mills. Students in assaying at the School of Mines have recently mixed their final pulps by pouring them, with shaking to and fro, at least ten times through a table-riffle. As far as can be determined in the course of the regular assaying, the riffle mixing is adequate. It will be explained in considerable detail.

"A riffle-cutter may be used to make either a few or an almost unlimited number of cuts during the division of a sample. Fig. 5 shows an operator pouring a sample through a riffle-cutter which has 26 slots. When the container rests on the edge of the cutter, and the material is merely allowed to flow through the 12 slots which include the width of the stream of ore, there will be six streams flowing into the sample, and the lot may be said to be cut six times for sample. When the operator moves the container across the top of the riffle, say 20 times during the pouring, all of the slots are brought into play and the lot may be cut 20 by 13, or 260, times for sample. The operator might, however, take the ore from the container in a scoop and then pour it through in small portions, shaking each scoopful 20 times across the riffle. If the operator takes a lot of ore in 10 scoopfuls, and pours each across the 26 slots, with 20 to-and-fro motions, he makes, altogether, 10 by 13 by 20, or 2600 cuts, for the sample.

"It is thus seen that a lot of ore is easily cut into a larger number of portions by merely shaking the ore-stream across the riffle. When the two halves of the divided sample have been united the lot of ore has been thoroughly mixed. Both gross and minute inequalities are dispersed throughout the sample by cutting and uniting several times; in other words, the lot has become unusually well mixed.

"I am of the opinion, that, if a sample is shaken 10 times across a riffle, which makes 1000 cuts for sample each time, the pulp will be as well mixed as by rolling 1000 times on a cloth. The riffle-mixing can be done in less than 5 minutes, while the rolling will rarely require less than 15 minutes.

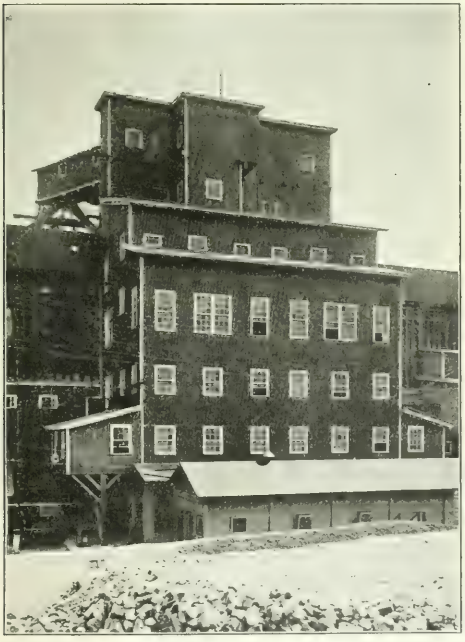
"In order to make an exact test of the mixing that can be done with a riffle I prepared 500 gm. of quartz and 500 gm. of iron ore by grinding each and passing them through a 100-mesh sieve. Each lot was, of course, dry and thoroughly mixed. The iron ore was poured over the quartz in a pan and then the whole was poured through a

12-slot riffle. It was given nearly 100 shakes during the 30 seconds required for the powder to flow from the pan. Two grab-samples of about half-gramme size were taken on a spatula from each half. The two portions were united and the operation repeated. This was done seven times and each time two grab-samples from each half were taken for analysis. The results were as follows:

Quartz, 3.17% iron; iron ore, 43.78% iron; average, 23.48% iron.

Number of mixings	Analysis for iron				Average	Average deviation from 23.48
	%	%	%	%	%	%
1	15.72	32.72	6.04	30.80	21.32	10.44
2	20.24	20.12	19.24	21.12	20.18	3.30
3	20.12	21.40	23.40	22.88	21.95	1.51
4	23.28	23.50	23.40	23.20	23.34	0.15
5	23.64	23.64	23.44	23.64	23.61	0.13
6	23.56	23.64	23.44	23.64	23.57	0.11
7	23.36	23.44	23.52	23.64	23.49	0.09

"The chemical analyses show that the first mixing had intermixed the iron ore and quartz to a considerable extent, while the second mixing made a nearly uniform product. The third mixing brought practically perfect



ANACONDA SAMPLING-MILL

average composition in streaks, while the fourth mixing doubtless rendered the entire lot homogeneous to within one part in one hundred, which is the accuracy of the chemical analyses, themselves. The 5th, 6th, and 7th mixings changed the composition in an almost inappreciable degree. The chemical determination of iron was chosen because it could be done more easily and with greater precision than almost any other determination or assay.

"Material which yields identical composition on haphazard samples fulfills the test of uniformity; this test is one of mixing rather than anything else."

It is needless to add that, when a lot of ore of the required fineness is passed over a riffle so as to make many hundred or a few thousand divisions, it splits the lot into two halves which are duplicates of each other. The repeated splitting of one of the halves thus quickly reduces

FIG. 5. STAND RIFFLE-CUTTER USED AT MONTANA SCHOOL OF MINES

the size of the lot to any smaller quantity that may be desired for a sample. Quoting further:

"Whenever the riffle-cutter has been tested under proper conditions it has given admirable results; it is, accordingly, strongly recommended wherever it can be used. The prospector and miner will find riffles both cheap and handy. Riffles can be used wherever coneand-quarter sampling or split-shovel sampling is now used. The utmost use of riffles will tend toward uniformity, low cost, rapidity, and the greatest possible precision in sampling.

"PROBABILITY SAMPLING WITH MECHANICAL CUTTERS. There is no doubt but that the results of sampling must follow some probability curve, mathematically determinable from the factors involved; the engineer makes certain that the curve shall be of the shape indicated in Fig. 6. The curve means that, depending on the number

of divisions or cuttings for sample, the probable result will lie within the extremely narrow vertical portion of the blackened area. On this basis, if the ore is repeatedly crushed between divisions so as to circumvent the influence of large single particles, the degree of accuracy is not obtained, although the crushing and dividing is repeated as many times as necessary to sufficiently reduce the size of the sample.

"The law of averages and the theory of probability demonstrate that if either single pieces or small portions of a large lot are chosen at random the composition of the selected portion finally will approach, as a limiting condition, the composition of the entire lot. Obviously, if one selects the entire lot, the sample and lot become identical. However, it is not necessary to take the entire lot, for by mixing and taking a sufficient number of single particles, or by making enough cuttings, or by a combination of mixing and dividing, it is possible to take not more than one-fifth, one-tenth, or even one-twentieth of the lot and still get a truly representative sample. Shovel-sampling, split-shovel sampling, riffle-sampling, and the use of all types of mechanical cutters involve more or less of the probability principle.

"To make the probability overwhelmingly on the side of precision, a questionable number of divisions is not made, but thousands of divisions, each portion containing thousands of particles, are made. Furthermore, the possibility of large pieces influencing the results is precluded, and any influence that can interfere with absolutely random division is avoided. Thus any influence which tends to select according to size, weight, density, color, hardness, porosity, or any other imaginable property is eliminated.

"In actual sampling the sequence of crushing and cutting is commonly performed from six to ten times. Each portion of the thousand or more selections made by one machine contains millions of particles and the final result has every assurance of correctness. The proof of this consists, not in analyzing the entire lot, which, as already stated, is impossible, but in repeating the process, in getting duplicate samples, or by sampling by an entirely different method.

"If a lot of ore weighing 50 tons requires 60 minutes to go through a mill whose mechanical cutters are taking out one-fifth at the rate of 60 cuts per minute and are in series of four, the first cutter will make 3600 selections and take out 10 tons containing millions of particles. After crushing, the second cutter will make its 3600 selections from the first sample and take out its two tons containing again millions of particles. Then the third cutter will divide the two-ton lot, making its 3600 selections and taking out 800 lb. containing again some millions of particles. The last cutter will divide the 800 lb. and with its 3600 selections take out 160 lb. in another sample likewise containing millions of particles. The process of crushing and dividing is then continued with suitable machines, usually in the bucking-room, until the final analysts' packets, each containing millions of particles, represents the original lot with the same precision as that of any previous larger selection or sample."

Probability sampling depends on certain other factors besides the number of cuts for accurate sampling; three of the most important are: (1) that the cutter-openings shall be large enough to pass the largest pieces without discrimination; (2) that none of the pieces shall be large enough to alter the results by falling individually in either sample or reject; and (3) that no valuable mineral shall be in such single rich aggregates as to affect the results when the piece containing the aggregate falls in either sample or reject. These conditions have been considered at length in the more important articles on sampling.

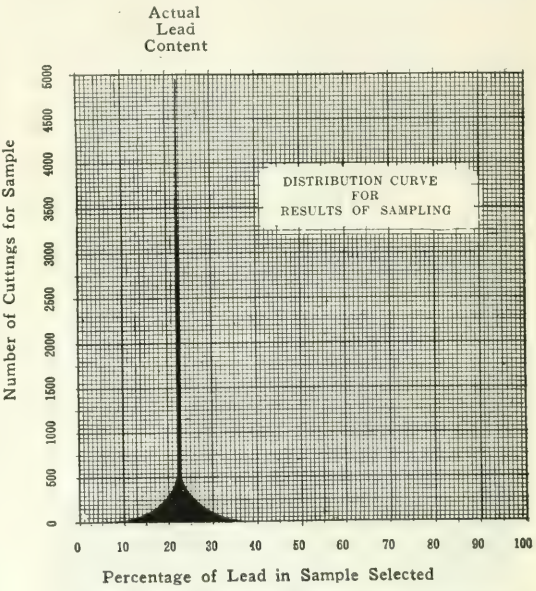
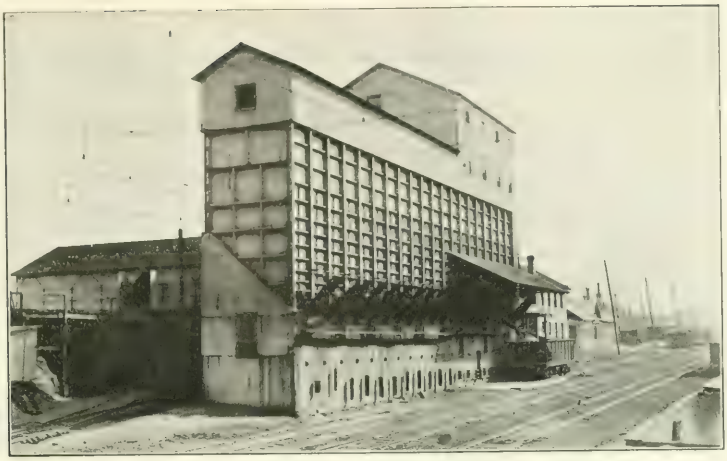


FIG. 6. PROBABILITY CURVE FOR DISTRIBUTION OF SAMPLING-RESULTS

EQUIPMENT OF MONTANA SAMPLING-MILLS. The Montana sampling-mills use the customary machinery for transferring ore from the railroad-cars or receiving-bins to the various places in the mill, and for finally disposing of it. Steel-pan conveyors, shaking-grizzley feeders, shaking troughs, bucket-elevators, belt-conveyors, and trolley-buckets are in use at the several mills. Crushing and grinding is done by gyratory breakers, jaw-crushers, rolls, ball-grinders, disc-grinders, and on bucking-boards. Sample-cutting is done with the Brunton vibratory cutter, the Brunton oscillatory cutter, the Vezin cutter, the East Butte cutter, and the Snyder cutter (at the State School of Mines) for mechanical work, and with split shovels, pipes, and stand and table-riffles for hand-sampling.

The Washoe sampler at Butte cost $150,000; it is constructed of steel and concrete and is capable of sampling



ANACONDA SAMPLING-MILL

500 tons in eight hours. Sample-cutting is done by Brunton oscillatory cutters. The mill will sample the usual lot of 50 tons of ore in about 25 minutes, and can then be thoroughly cleaned and blown out with compressed air during the few minutes required to dump the next carload of ore into the receiving bin. The facilities for shifting cars, weighing, storing lot and reserve-samples, and doing the bucking-room work promptly and accurately are superior to those of any other mill in the district. Crushing is done with a 20 by 10-in. jaw-crusher and 16 by 36, 14 by 30, and 12 by 24-in. rolls. The Brunton oscillatory sample-cutters have sample openings 7 by 10.5, 6 by 8, 4.5 by 6.75, and 3.5 by 5 in. and make 40, 28, 63, and 68 cuts, respectively, per minute. The bucking-room is equipped with split shovels, pipe-samplers, stand and table-riffles, bell and disc-grinders, bucking-board, and electric cabinet-dryer.

The East Butte sample-mill is a frame structure equipped with 12 by 24-in. crusher and 16 by 36, 10 by 24, and 9 by 9-in. rolls. The East Butte type of sample-cutter is used; the sample-openings are 8 by 12, 6 by 7.75, and 4.5 by 5.5 in., respectively. The rates of cutting are 28, 26, and 16 per minute. The mill has an unusually large stand-riffle cutter. In the bucking-room are individual units comprising steam-table and cabinet, small crusher, grinder, disc-grinder, and bucking-board. Samples are

FIG. 7. PIPE-SAMPLING OF FLOTATION CONCENTRATE

split with riffles and pulps are mixed by hand-rolling on a cloth. The most noteworthy feature of the mill is the use of drum-mixers above the second and third sample-cutters; they work smoothly and give their respective cutters better mixed and more uniform feed than is usual in the other mills.

The No. 1 mill at the American Smelting & Refining Co.'s plant at East Helena is served entirely by belt-conveyors. It is a steel and concrete mill capable of sampling 400 to 500 tons in an eight-hour shift. The precision of sampling at this mill should excell that of any other Montana plant since all material is customarily ground to pass a $\frac{3}{8}$-mesh screen before going to the sample-cutters. The fine grinding also assures time enough in sampling so that a 50-ton lot of ore almost inevitably gets 3000 sample-cuts by each of the four Vezins. The mill is equipped with No. 5 and No. 4 McCully gyratory crushers and two 16 by 36, and 12 by 12-in. rolls. The sample-openings in the Vezin cutters are 14 by 20 and 3 by 20 inches in the first, and 7 by 10 and 1.5 by 10 inches in the three succeeding cutters, while the samples are cut at the rate of 30, 34, 40, and 40 per minute. The bucking-room has ample equipment. Cone-and-quarter sampling is extensively used both on a large steel floor and in the bucking-room.

The Anaconda sampling-mill has a capacity of 2000 tons in eight hours. It is a frame structure piped for automatic sprinkling in case of fire. Most of the ore sampled is the low-grade copper from the company's mines at Butte. The mill is built and operated as two duplicate, but wholly independent, twin units; the equipment of one half only is described. Crushing is done by a 12 by 24 and an 8 by 18-in. crusher, and by 15 by 40 and 14 by 26-in. rolls. Sample-cutting is done by Brunton oscillatory cutters whose sample openings are 11 by 15, 7 by 11, 5.5 by 8, and 3.5 by 5 in., respectively. The number of cuts for sample are 24, 36, 44, and 76, in the same order.

The bucking-room at the Anaconda sampler is divided into twin units. It has steam-cabinet dryer, bell-grinders, disc-grinders, power-sieves, bucking-boards, cube pulp-mixers, and stand and table-riffles.

The sampling-mills in Montana do excellent work on low and medium grade ores. It is customary to clean the mills with compressed air between lots and all of the sample-cutting devices are capable of doing work of the required precision. Roll practice has not yet advanced to the recent idea of full and uniform feed, while corrugation of the shells sometimes exists to an undesirable extent. The mills are doubtless clean enough for sampling but are not sufficiently free from dust to meet approved hygienic standards. The precision of moisture-sampling appears to be capable of improvement; when equipment for handling dust is more generally used, it may be that 'air-conditioning' will come into vogue and there will be maintained inside the mill a 'climate' which will neither take nor give moisture to the sample as it is being cut and crushed during its progress through the mill.

Pumping on the Rand

G. H. Beatty describes the general arrangement of a pump-station on the 2500-ft. level at the North Deep shaft of the Randfontein mines on the Rand. The plant consists of four units of the well-known Sulzer type, each designed to deliver 84,000 gal. per hour against a head of 2500 ft. Each pumping-set consists of one five-stage right-hand suction-pump and one eight-stage left-hand pressure-pump. The pumps are coupled in series, and driven by an electric motor arranged between the pumps on a cast-iron base-plate common to pumps and motors. The motors are 1750 hp., and rotate at 1470 r.p.m. Delivery is through three 10-in. rising mains taken from the pump-station to the shaft at an angle of 50°, and thence to the surface. The mains are supported by ducks' feet on box-girders placed across bearers in the shaft, and are further supported at intervals in the shaft. Each main is provided with an expansion-joint placed half way up the column.

It does not seem to be the usual practice to have expansion-joints in water-columns, but they have some advantages. In this case the weight of metal in the columns is 270 tons, and the expansion-joints permit of two permanent points of support unaffected by expansion and contraction. There is little or no variation in the temperature of the mine-water, and under running conditions there is no expansion or contraction, provided the columns are always in use. But the water temperature is 72°F., and the shaft temperature averages about 52°F., so that when pumping through a column ceases, contraction commences. Loss in temperature of a column full of water is slow under the prevailing conditions, but if the column is drained the drop is rapid, and contraction correspondingly so. If it is necessary to put a column out of commission it is advisable to slack off the intermediate supports and allow its full weight to bear on the duck's foot and expansion-joint supports, otherwise strains are set up and trouble in the column follows. The North Deep shaft was commenced in September 1917. The permanent headgear was erected at once, and good progress made in the shaft. The high angle of dip of the strata was not conducive to record-breaking, and the 18th level-station (2500 ft. below the collar) was cut in March 1919. Shaft-sinking was stopped for two months owing to a delay in timber coming forward, and advantage was taken of the delay to install the rising-mains and cables, and lower the pumps and fittings to the chamber. All the pump-gear, motors, pipe-fittings, etc., were lowered to the pump-station in less than 49 hours by means of a specially designed cage slung below the skip. The cage was fitted with rails to take trolley loaded with the material.

The trolleys were run out of the cage over a drop-set and directly into the chamber, and unloaded by means of a traveling-crane which runs the full length of the chamber. The pumping-plant has now been in operation for five months. The water pumped during July and August amounted to 215,300,000 gallons.

The Mechanism of the Surface Phenomena of Flotation

By Irving Langmuir

*Notwithstanding the importance that the flotation process has assumed in the separation of ores, there has been comparatively little progress in the development of the underlying theory. It is recognized that the process depends on the formation of thin oil-films on the particles of ore and that owing to the difficulty with which these particles are then wet by water they become readily attached to the air-bubbles and are thus carried to the surface. As far as I know, however, no really satisfactory theory of these phenomena has been proposed. The remarkably selective action of some oils on certain ores and the effects produced by small amounts of acids and other substances are very imperfectly understood.

The object of this paper is not to offer a new theory of flotation, but rather to call attention to a theory of adsorption and surface-tension that greatly aids in understanding these phenomena and that therefore should prove useful in developing any comprehensive theory. Some simple experiments will be described showing that the new viewpoint is applicable to flotation processes.

The surface phenomena of flotation may be divided roughly into three classes: the formation and properties of the froth; the oiling of the solid particles; and the adhesion of the oiled particles to the bubbles of the froth. The formation of the froth depends on the existence of a film of oil or other substance at the boundary between the air and water phases. The oiling of the solid particles involves the formation of a similar film at the surface of the solid. The adhesion of the particles to the bubbles depends primarily on the ease with which oily water wets the oily solid and this in turn is measured by the angle of contact between these oiled liquid and solid surfaces. The formation of the oil-films on the surfaces of the water and the solid particles is a typical case of adsorption, so that an understanding of the fundamental phenomena of flotation requires a knowledge of the nature of adsorption.

For several years I have been engaged in a study of high-vacuum phenomena, especially the effects produced when various metals are heated in gases at very low pressures. In some cases the rate of disappearance of the gas was measured, while in others the electron emission from the heated metal was observed. In the course of this work it was frequently found that adsorbed films of extraordinary stability were formed on the surface of the metal. The evidence from a large number of such experiments indicated clearly that these stable films consisted of a single layer of atoms chemically combined with the underlying atoms of the solid. The adsorbed atoms were chemically saturated, but the atoms in the surface of the metal were not saturated by their combination with the adsorbed atoms and therefore remained firmly held by the next underlying layer of metal atoms. This viewpoint was based to a large extent on the work of Braggs on crystal structure.

The atoms in the stable films are clearly held to the surface by direct chemical union of the primary valence type, like that holding oxygen to carbon in carbon di-oxide. Further investigation showed that in some other cases of adsorption, such as that of nitrogen or argon by charcoal, etc., the forces involved, although no less chemical than the others, were of the type represented by secondary valence such as that holding water of crystallization, or ammonia in complex ammonia derivatives.

A further extension of this theory led to the view that no fundamental distinctions should be drawn between the so-called physical phenomena and those recognized as chemical. Thus condensation of vapors, crystallization, surface-tension, adsorption, etc., are manifestations of forces of the same kind as those involved in the formation of chemical compounds.[1]

From this viewpoint, the forces involved in the adsorption of organic substances with large molecules do not originate from the molecule as a whole, but rather films in general should be one molecule in thickness. Lord Rayleigh in 1899 (Phil. Mag. 48, 331 (1899)) observed that a film of olive-oil just thick enough to lower appreciably the surface-tension of water had a thickness of 1.0×10^{-7} cm. He stated: "Now this is only a moderate multiple of the supposed diameter of the gaseous molecule, and perhaps scarcely exceeds at all the diameter to be attributed to a molecule of oil. It is obvious, therefore, that the present phenomena lie entirely outside the scope of a theory such as Laplace's in which matter is regarded as continuous and that an explanation requires a direct consideration of molecules. If we begin by supposing the number of molecules of oil upon a water surface to be small enough, not only will every molecule be able to approach the water as closely as it desires, but any repulsion between molecules will have exhausted itself. Under these conditions there is nothing to oppose the contraction of the surface—the tension is the same as that of pure water."

If the molecules "behave like smooth rigid spheres of

*Abstract of a paper read before the Faraday Society on July 14, 1919.

[1]The evidence for these conclusions is given in the following papers by the writer: 'Chemical Reactions at Low Pressures', Jour. Amer. Chem. Soc., 37, 1139 (1915); 'The Constitution and Fundamental Properties of Solids', Jour. Amer. Chem. Soc., 38, 2221 (1916); and 'The Adsorption of Gases on Plane Surfaces of Glass, Mica, and Platinum', Jour. Amer. Chem. Soc., 40, 1361 (1918). A review of this work is given by Wm. C. McC. Lewis in his recent 'System of Physical Chemistry', Longmans, Green & Co., 1918, Vol. I, pp. 461-474.

gaseous theory, no forces will be called into play until they are closely packed. According to this view the tension would remain constant up to the point where a double layer commences to form. The actual course of the curve of tension deviates somewhat widely from the above description, but perhaps not more than could be explained by heterogeneity of the oil, whereby some molecules would mount more easily than others, or by reference to the molecular motions which cannot be entirely ignored. If we accept this view as substantially true we conclude that the first drop in tension corresponds to a layer one molecule thick, and that the diameter of the molecule of oil is about 1.0×10^{-7} cm."

By a similar method Devaux (Ann. Report Smithsonian Inst., Washington (1913), 261) concludes that the diameter of the molecule of triolein is 11.3×10^{-8} cm. if the molecule be assumed spherical in shape.

According to the present theory, however, molecules should not be regarded as spheres, since such a supposition is not consistent with the chemical nature of the forces. The spreading of an oil on the surface of water is therefore due to an attraction between the water and some active group in the oil molecule. If the molecule as a whole had an affinity for water it would render it soluble in water. It is known that the presence of – COOH, = CO, or – OH groups in an organic molecule increases the solubility in water while the hydrocarbon chain decreases it. On the other hand, hydrocarbons are soluble in each other. When an oil containing the carboxyl group is placed on water these active groups combine with the water, while the hydrocarbon chains remain combined with each other by secondary valence forces. On an unlimited surface the oil thus spreads until all the – COO – groups have come into contact with the water, forming a mono-molecular film. A pure paraffin-oil, since it contains no active groups, does not spread on water.

By measuring the greatest area of water that can be completely covered by a small weighed amount of oil, it is possible to determine the cross-sections and lengths of the molecules. The thickness of the oil-film gives the length of the molecule measured vertically, while the area covered by each molecule gives its cross-section. Results obtained this way show that the molecules in oil-films are not even approximately spherical. This is shown by the data of Table I.

Thus the molecules of the fatty acids from palmitic to cerotic are all of the same section, but their length increases in proportion to the length of the hydrocarbon chain. Tristearine has a cross-section three times that of stearic acid, but the length of the molecule is the same. The areas covered by the oils or fats are thus proportional to the number of active groups present. The molecule of cetyl palmitate is nearly ten times as long as it is wide ($\sqrt{a}$), while the molecule of triricinolein (castor oil) has a length only about one-third of its width. The results show that these differences of shape are strictly in accordance with the theory of the chemical nature of the phenomena.[2]

Table I

Cross-section a, and length t of molecules

Substance	Cross-section a sq. cm.	$\sqrt{a}$ cm.	Length t cm.
Palmitic acid, $C_{15}H_{31}COOH$	22×10^{-16}	4.7×10^{-8}	21.4×10^{-8}
Stearic acid, $C_{17}H_{35}COOH$	22	4.7	23.8
Arachidic acid, $C_{19}H_{39}COOH$	22	4.7	25.9
Cerotic acid, $C_{25}H_{51}COOH$	22	4.7	33.0
Cetyl alcohol, $C_{16}H_{33}OH$	21	4.6	21.9
Tristearine, $(C_{18}H_{35}O_2)_3C_3H_5$	69	8.3	23.7
Cetyl palmitate, $C_{15}H_{31}COOC_{16}H_{33}$	21	4.6	44.0
Oleic acid, $C_{17}H_{33}COOH$	48	6.9	10.8
Erucic acid, $C_{21}H_{41}COOH$	44	6.6	14.2
Triolein, $(C_{17}H_{33}O_2)_3C_3H_5$	145	12.0	11.2
Linoleic acid, $C_{17}H_{31}COOH$	47	6.9	10.7
Linolenic acid, $C_{17}H_{29}COOH$	70	8.4	7.1
Ricinoleic acid, $C_{17}H_{32}(OH)COOH$	100	10.0	5.2
Castor oil, $[C_{17}H_{32}(OH)COO]_3C_3H_5$	290	17.0	5.5

In liquid hydrocarbons of the paraffin series the methyl groups at the ends of the hydrocarbon chains form the surface layer. The surface is thus the same no matter how long the chain may be. As a matter of fact, the surface-energy[3] of all the hydrocarbons from hexane to molten paraffin is substantially constant, namely 46 to 50 ergs per square centimetre, although the molecular weights differ very greatly.

If now we consider the alcohols, CH_3OH, C_2H_5OH, etc., we find that their surface energies are practically identical with those of the hydrocarbons. The reason is that the surface layer in both cases consists of CH_3 groups. With such substances as CH_3NO_2, CH_3I the surface energy is much greater than that of the hydrocarbons. This is partly due to the fact that the large volume of

The same theory has been applied to surface-tension phenomena in general. According to this theory the molecules of organic liquids arrange themselves in the surface layer in such a way that their active portions are drawn inward, leaving the least active portion of the molecule to form the surface. Surface-tension is a measure of the potential energy of the stray field extending out from the surface layer of atoms. The molecules in the surface layer arrange themselves so that this potential energy is a minimum. The surface-energy of a liquid is thus not a property of the molecule as a whole, but depends only on the *least active portions of the molecules* and on the manner in which these are able to arrange themselves in the surface layer.

[2]The experimental and theoretical work underlying the above statements has been published in the following papers by the writer: 'Surface Tension Phenomena', Met. Chem. Eng., 15, 468 (1916); 'The Shapes of Group Molecules Forming the Surfaces of Liquids', Proc. Nat. Acad. Sciences, 3, 251 (1917); 'The Constitution and Fundamental Properties of Liquids', Jour. Amer. Chem. Soc., 39, 1848 (1917). A short summary of some of this work has been given by Wm. C. McC. Lewis, 'Physical Chemistry', Vol. I, p. 474.

[3]The total surface energy γ_0 is related to the surface-tension γ by the equation $\gamma_0 = \gamma - T\,(d\gamma/dT)$ where T is the absolute temperature.

the NO_2 or I forces the CH groups apart and increases the surface energy. It is apparent that considerations of this kind must be of fundamental importance in connection with the thory of the flotation process. Before much progress in this direction can be made, however, it is necessary to develop experimental methods for the investigation of oil-films on solid bodies. With this end in view I have undertaken some simple experiments.

Experiments

A study was first made of the properties of cleaned and oiled glass surfaces. It was especially desired to find how much oil must be present on a glass surface to alter materially its properties.

Microscope slides were washed with soap and water, were heated in a mixture of concentrated sulphuric acid and chromic oxide, and were finally washed in running tap water and dried over a Bunsen-burner flame. During this whole treatment they were held in a pair of forceps. This method of cleaning proved to be much more thorough than any other method tried.

When a drop of clean water is placed on a slide cleaned in this way the water wets the glass readily, and when the slide is inclined the surplus water runs to one end, leaving a thin film of water over the whole surface of the glass. Another indication of the cleanliness of the surface is obtained by dipping the slide into a clean surface of water onto which a small amount of talc powder has been dusted. The talc particles are not repelled from the glass surface if it is clean, but very small amounts of grease can be detected by the motion of the talc particles produced by the spreading of an oil-film on the surface of the water. This test for the cleanliness of a surface will be referred to as the talc test.

Another characteristic of a thoroughly cleaned glass surface is the extraordinary friction observed when the glass is rubbed with another clean piece of glass or platinum. Lord Rayleigh[4] has recently called attention to this fact and pointed out its significance in connection with the theory of lubrication. It is also interesting to note that Faraday in his 'Experimental Researches' (paragraph 369) mentions the "peculiar friction" observed when a platinum rod was rubbed over a surface of a platinum plate which had been thoroughly cleaned by making it cathode in electrolysis or by heating it in concentrated sulphuric acid.

In order to study this effect quantitatively, some small glass sliders ranging from 0.2 to 1.0 gramme in weight were made by bending glass rods in the form of a horseshoe and well rounding the ends. The two arms of the horseshoe were then arched in a plane perpendicular to the original plane of the horseshoe, so that when the slider was laid on a flat surface it touched in three definite points. If one of these sliders was placed on a clean slide, it was found that the slide could be tilted usually to an angle of 70° from the horizontal, often 75°, and in some cases 90° or even 92°, before it would begin to slide. Of course, before beginning this test it is essential to clean the slider by the method already given. If the slider was forced over the surface of the slide a squeaking noise was always heard if the glass was clean and the surface of the glass was scratched perceptibly in the process. It was found that much more consistent results were obtained by means of a pair of forceps. The angle was measured at which the slider would just stop moving after being set in motion by the forceps. The sliding-angle thus found varied between 50° and 60° for different samples of glass cleaned by the method described. On standing in the air for a short time the surface becomes slightly contaminated, so that the sliding-angle decreases. Thus, after three minutes the angle is 45°, after 20 minutes 40°, after two hours 22°. This contamination is also shown by the talc test. The actual size of the slider used seemed to be without effect on the results.

In order to put a mono-molecular film of oil on a glass surface the following method was adopted. The surface of water in a long narrow tray was cleaned by scraping with a strip of paper extending across the tray. A very small quantity of oleic acid was placed on the water at one end of the tray and the spreading of the film was made visible by traces of talc powder. By adding the oil in very small portions the surface was finally saturated with oil without leaving any globules of oleic acid except at the end of the tray at which they had been added. Previous work had shown that an oleic-acid film formed in this way has a thickness of 22×10^{-8} cm. and consists of a single layer of molecules each occupying an area about 24×10^{-16} sq. cm., the spacing thus being the same as that of stearic acid and the other saturated fatty acids. The cleaned slide was then dipped edgewise into the water covered by this film and slowly withdrawn. As the slide was raised it remained at first wetted by the water and the film of oil spread itself over the newly formed water surface. The motion of small particles of talc showed that the oil-film moved upward at the same rate as the slide was raised, so that there was no concentration of oil on to the surface of the glass. When a clean slide is originally dipped into the water the talc particles close to the surface do not move either toward or away from the slide. This indicates that no oil goes on to the glass surface while this is being lowered into the water. This remarkable fact is confirmed by removing the oil-film from the surface of the water by scraping and blowing before withdrawing the slide from the water. If the slide is then dried at ordinary temperature it is found both by the talc test and the friction test that the surface is still entirely free from oil. If, on the other hand, the slide has been raised from the surface saturated with oil and is held in a vertical position the water-film gradually moves down and the oil-film on it comes into contact with the glass. The same result may also be obtained by holding the slide in a horizontal position and allowing the water to evaporate. In this way the glass surface is covered with a film of oil of the same thickness as that originally present on the surface of the water.

[4] 'Phil. Mag.', 35, 157 (1918).

A slide treated in this way appears just as clean as before, but if dipped in clean water it is found that the water no longer adheres to it but gradually runs off, as from a greasy surface. The talc test gives a rather slight indication of contamination, but if the slide is raised and lowered repeatedly in pure water, or is passed several times through a gentle stream of running water, it soon loses its ability to contaminate water. The friction test gives a sliding-angle of about 60° to 10°, whether or not the surface has been washed by clean water before drying.

In other experiments the film of oleic acid was allowed to expand on the water surface until the surface-tension was nearly that of pure water. The thickness of such a film (see Table I) is 11×10^{-8} cm., and the area covered per molecule is 48×10^{-16} sq. cm. A glass slide oiled by dipping and slowly withdrawing from this oiled water and drying in a horizontal position gave sliding-angles ranging from 6° to 20°. The results were rather erratic and indicated that the oil was not uniformly distributed over the slide, but was concentrated somewhat on those portions which were the last to dry. If the slide was allowed to dry in a vertical position, the upper part of the slide was found entirely free from oil, while the rest of the slide was uniformly covered.

Freshly split mica (biotite) is very readily wetted by water and by paraffin-oil, but oleic acid and molten stearic acid form globules. These acids, however, leave the surface greasy even after the globules have been removed.

A smooth piece of platinum foil ($1\frac{1}{2}$ by 3 inches) was polished with sea-sand and ignited to a red heat. It was readily wet by water. As in the case of glass and mica, platinum does not become contaminated when dipped into oiled water, but only when it is drawn out and dried. Clean platinum gives a sliding angle of 35° with a platinum slider, and 30° with a glass slider. After dipping once in water saturated with oleic acid and drying, the sliding-angle with both glass and platinum sliders was 14°.

Fresh cleavage-surfaces or fractures of calcite, sphalerite, galena, pyrite, and magnetite were all readily wetted by water or paraffin-oil, and in each case the paraffin-oil was readily displaceable by water. The clean surfaces all became greasy by dipping into water saturated by oleic acid, and in every case it was impossible to remove the greasiness by repeatedly passing through a stream of water. On cleavage-surfaces of calcite and galena rough qualitative observations showed that there was a peculiar friction, as in the case of glass.

Measurement of Contact-Angles of Drops of Water on Oiled Surfaces

Simple observation showed that drops of water behaved rather differently on various solid surfaces that had been dipped into water saturated by oleic acid.

Drops of water placed on oiled glass flattened out to a layer about 2 mm. thick. By tilting the glass the drop would advance over the surface at the lower edge, forming a rather large angle of contact, while at the rear edge the water would recede from the glass rather slowly, and the angle of contact was much less than at the advancing edge. The moving drop was usually rather irregular in outline. On mica the depth of the drop is less than on glass, and the drops are more irregular in shape after moving over the surface. With platinum the drops of water become thicker and more symmetrical in shape, while on galena they show a still greater thickness and regularity.

To obtain more definite information, drops of water ranging from 0.7 to about 1.22 cc. in volume were placed on oiled surfaces and their heights measured by a vernier attached to a fine point brought into contact with the drop and subsequently with the solid surface on which the drop had rested. The results are given in Table III. The figures in the colums marked h represent the depths of the drops in millimetres, while θ is the average contact-angle as calculated from the equation

$$(1) \quad h = 2\sqrt{2} \sin (\tfrac{1}{2}\theta)$$

where a is given by

$$(2) \quad a = 2\sqrt{\gamma/(g\rho)}$$

Here γ is the surface-tension; g the acceleration of gravity, and ρ the density of water. This equation is accurate only for large drops. Those actually used ranged from 1.4 to 2.5 cm. in diameter, and a further increase in the size of the drop did not appreciably alter the value of h.

In each case the oily surface was prepared by dipping a very small amount of cleaned (or cleavage) surface into water saturated with oleic acid, and drying at low temperature. The water drop was then placed on the surface and this was shaken and sometimes tilted slightly, so that the drop reached a stable shape. The results given are the averages of several observations. In most cases the individual observations on different drops agreed within about 0.1 mm. in the value of h.

The measurements of the column marked I were made with drops of clean water. In many cases the drops are slightly contaminated by oil from the solid surface. In every case a very small amount of talc was dusted on to the drop after measuring it, and by gently blowing on it the contaminated surface was forced to one side where its area could be estimated. The areas were always less than about 60 or 70% of the whole surface, so that the surface-tension of the drop could not have been appreciably affected. This conclusion was checked in some cases by re-

Table III

Height and Contact-Angles of Water Drops on Surfaces Covered by Mono-molecular Films of Oleic Acid

	I. Clean water		II. Water saturated with oleic acid	
	h	θ	h	θ
Solid	mm.			
Mica	0.9	18°	0.9	24°
Quartz	..	..	1.2±	31°±
Glass	2.1	45°	1.5	42°
Platinum	2.9	65°	2.45	72°
Calcite	3.1	70°	2.75	82°
Sphalerite	3.6	82°	3.0	92°
Galena	3.7	86°	3.35	106°

peating the measurements after the surface had been washed by passing through a stream of running water until drops placed on the surface were no longer contaminated. In each case (except mica) the results remained unaltered. In calculating the angles of contact, δ in the above equation (2) was placed equal to 72.8, so that equation (1) became

$$(3) \quad h = 0.456 \sin \tfrac{1}{2}\theta$$

The measurements given in the second column of Table III were made after the drops of water had been touched by a wire dipped in oleic acid. In this case δ of equation (2) was taken to be 42.8, so that the coefficient of equation (3) was 0.418 instead of 0.456.

Discussion of Experimental Results

The experiments have shown clearly that oil-films of molecular thickness are sufficient to alter radically the surfaces of solids. This is shown not only by the lubricating properties of these films but also by the contact-angles made by drops of water.

The properties of these mono-molecular films as measured by the contact-angles depends apparently as much on the character of the underlying solid as upon the nature of the oil. Thus the minerals galena and sphalerite give much larger contact-angles when contaminated by oleic acid than those obtained with glass or quartz under similar conditions. This result seems to be inconsistent with the theory of surface-tension discussed in the early part of this paper, according to which the surface-tension depends only on the nature of and arrangement of the atoms forming the actual surface. From this viewpoint, we would be led to believe that the upper surface of oil-films on solid bodies should in every case consist of CH_2 or CH_3 groups, and thus the properties of all the films should be similar. However, there is an important distinction between the case of an oil-film covered by a water drop and the surface layer of a pure organic liquid. The water drop on the film tends to draw the active groups to itself. In the case of oleic acid there are two active groups in the molecule, namely, the carboxyl and the double bond. It is probable that in some cases both of these are rather firmly held by the underlying solid, while in others only the carboxyl group is so held and the double bond is free to come in contact with water. Thus on galena we may assume that both active groups are held by the solid so that the water has only a little more tendency to spread on the oiled surface than on solid paraffin. With glass, on the other hand, some of the active groups may be brought to the upper surface by contact with water so that the water spreads much more easily than over paraffin. This theory readily explains the marked difference between the contact-angle of an advancing and receding surface on glass contaminated by oleic acid.

Another factor which must be taken into account is that the spacing of the molecules in oil-films on solids must be determined primarily by the surface lattice of the solid, whereas with films on liquids the molecules are able to arrange themselves largely without reference to the underlying liquid. As a result the films on solids are ordinarily not in stable equilibrium; many molecules are crowded into spaces too small for them, while others may occupy unnecessarily large areas. As a matter of fact, in all the experimental work with films on the solids the results were much more irregular and depended much more on slight differences in the previous history of the film than was the case with films on liquids.

The peculiar property of mica in giving such a small sliding-angle even when cleaned indicates that the surface is covered with water molecules with their hydrogen atoms thoroughly saturated and turned outward to form the surface layer. The great ease with which mica cleaves and the readiness with which oil-films can be washed off and water can spread on these oil-films is also a result of the small residual field of force extending out from these surface hydrogen atoms.

Application to the Theory of Flotation

The formation of froth depends on the presence of substances that can form a stable mono-molecular film over the surface of each bubble. In order that froth may readily form it seems to be desirable to have present a soluble substance having a strong tendency to be adsorbed on the surface of the liquid. For example, a small amount of acetic acid added to water produces a rather unstable froth. As we go to the higher fatty acids, for example, valeric acid, the tendency to form a froth is much increased. On the other hand, oleic acid does not readily produce a froth unless it is rendered soluble in water, as, for example, by forming soap by the addition of sodium hydroxide. Oil of pine-tar, so often used as a frothing-agent, contains soluble substances that probably act in this way. The presence of alkalies in flotation is to be avoided probably because the hydroxyl ion tends to draw the carboxyl group of the fatty acid to itself rather than to allow it to attach itself to the solid particles.

The particular properties of different kinds of oils must be made the subject of further careful study. The presence of small amounts of acid and substances that become adsorbed on the solid surfaces or attach themselves to the oil-films would be expected to alter the results materially. This subject is, of course, a very large one, and will necessitate much experimental work before it becomes well understood.

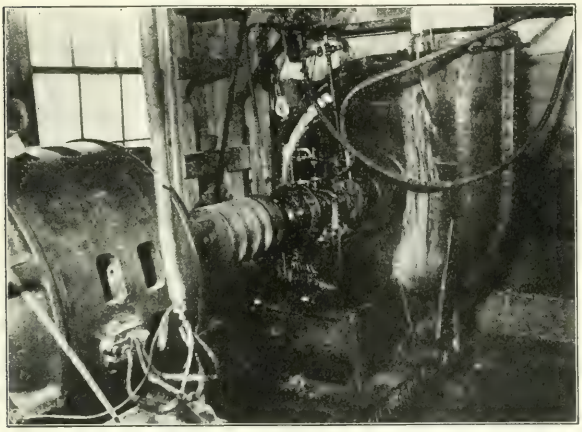
The tendency of the particles to attach themselves to the bubbles of the froth is measured by the contact-angle formed between the oily surface of the bubble and the contaminated surface of the solid. For the case where oleic acid forms both films the data given in the second column of Table III are applicable. The results indicate that the selective action by which substances like galena are separated from quartz and calcite is dependent upon the contact-angle formed by the oiled surfaces rather than by any selective tendency for the oil to be taken up by some minerals more than by others.

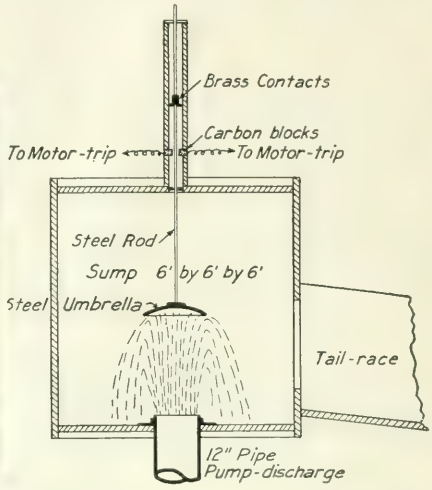
Three dredges formerly operated in Alaska by the Yukon Gold Co. have been moved to the Malay peninsula where they are now ready to commence dredging for tin.

Pump for Elevating Tailing

This device was put into use in June 1916 for the purpose of elevating the tailing from the jigs for distribution on the tailing-dump at the West mill of the Bunker Hill & Sullivan company at Kellogg, Idaho.

It consists of a 12 by 24-in. Byron Jackson centrifugal pump of the 1915 design, direct-connected to a 75-hp. Westinghouse motor running 500 r.p.m. and consuming 61.6 hp. under full load. The pump handles 600 tons of tailing per 24 hours, ranging in size from $1\frac{1}{4}$ in. to 20-mesh. It also handles 4500 gal. of water per minute, and discharges at an elevation of 25 ft. from the centre of the intake.





The pump discharges vertically into a sump, 6 by 6 by 6 ft., the pulp flowing out of this sump over a weir into the tailing-flume, which is 32 in. wide and three feet high. The flume has white-iron riffles six inches high set on edge across the flume every two feet for a distance of 200 ft., forming a bed of tailing in the bottom for a wearing-surface. The remainder of the flume is protected in the same manner with 6 by 6-in. blocks for riffles.

A white-iron runner in the pump lasts about 30 days, a white-iron follower about six months, and a liner made of car-wheel iron lasts a little over a year. One casing has been used in three years.

In order to protect the pump when, for any cause, such as the runner wearing out, the volume of water discharged is insufficient to carry the tailing away, thus filling the discharge-pipe with tailing, a device shown in the accompanying sketch was invented by Edward Hearing, the mill-foreman. It consists of a steel 'umbrella' upon which the stream from the pump impinges. To this umbrella a rod is attached which extends upward through a box in which are placed two carbon blocks forming the electrodes of a current passing through a no-voltage release, or trip, on the motor connected to the pump. At a proper place upon the rod, two brass contact-points are fastened, so that when the fountain of water from the pump lowers to a dangerous point, these contacts rest upon the carbon blocks, completing the circuit through the trip at the motor, and stop the motor.

Provision is made for automatically taking care of the feed to the pump by gravity flow when the pump is not running and also during the five-hour period required to change the runner in the pump.

FROM OUR OWN CORRESPONDENTS IN THE FIELD

COLORADO

CRIPPLE CREEK MINES PASS DIVIDENDS.

CRIPPLE CREEK.—The Portland Gold Mining Co. has announced temporary discontinuance of dividends, "until mining conditions improve and the efficiency of miners increases". The statement to the stockholders says that the mine and mill are in splendid condition "but mining costs are high and $2 ore with a profit of $1 is not worth while". The company has paid dividends for 26 years; 17 of these were regular distributions, and the total to date is $11,692,080. The last dividend of two cents per share was paid on October 20. No mining company in the district is now on a dividend-paying basis.

GEORGETOWN.—Operations have been resumed on the Josephine in Grizzly gulch, where a new shaft is being sunk near the tunnel portal to prove-up the vein. If ore is proved continuous a new tunnel will be started to open the shoot at much greater depth. The Denbigh corporation has installed a compressor, and winter operations will be carried on by machine-drills.

The Georgetown tunnel is reported showing porphyry and quartz in the heading with low silver value and a trace of gold. The tunnel is making water, indicating the proximity of a vein.

HOT SULPHUR SPRINGS.—The Electro Copper Co., owning 160 acres in the Harmony Creek district in Routt and Eagle counties, 44 miles from here, is developing a good copper prospect. Samples from the blanket formation opened by tunnel and shafts, all in ore, range from 5½ to as high as 37% copper. The company has purchased machinery and will install an electrolytic plant. The Moffat road traverses the property, a townsite has been surveyed, and camp established.

LAKE CITY.—The Standard Mines Development Co. has awarded a contract for the extension of the lower tunnel on the Little Chief to cut at depth an ore-shoot in an upper tunnel that is producing silver-lead ore running as high as $100 per ton. Machinery and equipment for the Colorado Consolidated property at Sherman has been delivered. A new power-plant is under construction and a mill is planned for the spring of next year.

LEADVILLE.—John Cortellini, president of the Park Tunnel company of Aspen, has returned from an examination of the property and reports the orebody 10 ft. thick. A streak 4 to 10 in. wide sampled 90 to 150 oz. per ton. Shipments cannot commence until the new road is completed.

TELLURIDE.—Late shipments were as follows: Valley View Leasing Co., 6 cars concentrate from the Matterhorn mill; Belmont-Wagner, 3 cars; Favorite, 1 car crude ore. A find of rich ore has been made by the Valley View Leasing Co. on the Matterhorn, where 12 in. of tetrahedrite with high silver content has been opened.

MICHIGAN

NO SHIPMENT OF COPPER EXPECTED DURING WINTER.—RECLAMATION PLANT IN STEADY OPERATION.

HOUGHTON.—It is unlikely that any copper will be shipped East by rail this winter. Not only are freight-rates high, but there is limited demand for the metal and there are enormous quantities in storage in the Eastern centres. Lake shipments were heavy in November, amounting to 16,468,000 lb., which was much more than was produced that month. Most of this metal went into storage. Total shipments by water for the year were 69,624,000 lb., also far above the production basis for the six months of the season of navigation.

Although the curtailment program is in full operation at Calumet & Hecla, production from the conglomerate shafts should measure up to that of October. There has been little reduction of forces in this department and the operation of additional stope-scrapers in the various shafts will contribute considerably to the output. The scrapers that were in use in the Osceola branch have been transferred to the conglomerate. Under favorable conditions, one scraper has turned out 67 cars of 'rock' of a capacity of slightly over two tons each on a shift, while the ordinary record by hand-tramming has been from 12 to 14 cars. The use of the scrapers will materially decrease the cost. The 81st level haulage-way in the conglomerate department is progressing, although no great speed is being made. The rails have been laid practically up to the present terminal. Not only will the tunnel permit of deeper mining by means of sub-shafts, but it will enable the company to realize an immense production from its shaft pillars, once the haulage-way proceeds far enough to permit the closing of the shafts between No. 12 and the Red Jacket shaft, which is the ultimate aim. The time when the shafts will be abandoned, however, is still far in the future. It is estimated that it will be at least a quarter of a century before the solid strip of conglomerate 'rock' constituting the pillars is entirely removed, for there is a wall 8000 ft. long and 200 ft. wide paralleling each shaft at the Hecla and South Hecla branches. It was the original practice in mining to sink the shafts right into the lode, and to prevent the

shafts from caving there is a conglomerate wall 100 ft. on either side of each shaft. In the upper levels the walls contain as much as 75 or 80 lb. of copper per ton, and all the way down the pillars are just as rich as the arches and backs of stopes that now contribute considerable quantities of copper to Calumet's output. The removal of the pillars is done upward, a method that permits the 'rock' to drop by gravity through chutes. The closing eventually of all the conglomerate shafts except No. 12 and the Red Jacket will result in a considerable decrease in costs, inasmuch as all hoisting will be done through the Red Jacket branch. No. 12 will be used as a supply shaft. The haulage-way will be approximately a mile and a half long. The output of the Calumet & Hecla reclamation plant continues at better than 1,000,000 lb. monthly. It is estimated that the production of the plant for the year will be 15,000,000 lb., an increase of approximately 6,000,000 lb. over 1919 or 1918. Fixing the output for the year at 15,000,000 lb., the total recovery since the reclamation project started is close to 50,000,000 lb. and the huge sand pile in Torch Lake still contains millions of pounds of copper. There are prospects of even a higher recovery in 1921, for the reason that two additional flotation units will then be in operation. Work on the extension to the plant is progressing, the steel work having been completed. It is expected that the new units will start in the spring. They will permit the application of oil-treatment to all of the reclamation sand, 25% of which is now returned to the lake without being subjected to oil-treatment. Six furnaces are now 'down' at the Calumet & Hecla smelter. Two furnaces, each with a capacity of 1,000,000 lb. of refined copper per month, remain in operation.

Seneca's 5th level, north, has passed through a stretch of unusually rich ground in which barrel or mass copper predominates and the south level also is breasted in a good grade of 'rock'. The showing on this level is considered good, and mineralization apparently is heavier than on the levels above. The 3rd and 4th levels are still going forward in fairly good ground and will be continued. Sinking is under way, with the bottom slightly below the elevation of the 6th level. Both the north and south drifts on the 5th level are approximately 150 ft. long, and good progress is being made in extending them. In its development work, Seneca is making occasional shipments to the Baltic mill. During the early part of November, Gratiot, owned by Seneca, made a mill-test from its stock-pile at the mine. A total of 446 tons of 'rock' was stamped, yielding 33,704 lb. or 75.56 lb. per ton. This tonnage was taken from the stock-pile after the usual discard had been made from the run-of-mine. All of the 'rock' came from the development of the 13th level, south, of No. 2 shaft, which level, from the shaft southward to the Mohawk boundary, has shown good mineralization. Two raises are being made on the 13th to the 11th level and these have reached a height of 100 ft., showing good mineralization. The mill-tests indicate a copper content in both the Seneca and Gratiot higher than the most sanguine estimates.

NEVADA

FREIGHT-RATES ON ORE CONSIGNED TO WABUSKA SMELTER ARE REDUCED.

RENO.—The railroad-rate hearing before an examiner for the Interstate Commerce Commission has been concluded and each side has been given 30 days in which to file briefs. The mining interests of the State, through Henry M. Rives, secretary for the Nevada Mine Operators' Association, and others, made a strong protest against further increases, pointing out that the industry in Nevada in its present condition would be hit hard by another increase. K. K. Gartney, an examiner for the Interstate Commerce Commission, in the Wabuska smelter case, has ordered the Western Pacific railroad to establish a rate of $3.53 per ton on ore shipped to Wabuska. This is taken to mean that the Wabuska smelter of the Mason Valley Mines Co. will be re-opened and enlarged, which would provide a market for copper producers over a large area in Nevada and California. The Wabuska smelter was closed because of a rate of $9.10 per ton from Plumas county points and corresponding rates from Nevada districts as against $8.80 to the smelter at Garfield, Utah, a condition that gave the Utah plants all of the ore that formerly went to Wabuska. The Mason Valley asked for a rate of $3.50. The decision is considered of great importance to Nevada mining, and there is little probability that it will be reversed, according to S. W. Belford, attorney for the smelting company.

DIVIDE.—The south-east drift on the 800-ft. level of the Tonopah Divide is being driven in a shoot of ore that is believed to have been entered too far north-west to be the extension of any ore found on the fifth level and, particularly as the ore is sulphide, the find is considered to be of great importance. The ore has been of shipping grade for nearly 100 ft., according to reports, mine-car samples giving assay returns of as high as $400 per ton. The average value is about $35, according to rough sampling. The drift on the 1000-ft. level, also being driven south-east, the direction of the rake of the ore-shoots, is in low-grade material and it is close to where the extension of the ore on the 800-ft. level should be entered.

TONOPAH.—A station is being cut at the 1880-ft., or bottom, level of the Victor shaft of the Tonopah Extension. From this point the western part of the company's territory will be explored. The McKane shaft, from which connection will be made with the 1540-ft. level of the Victor, is now 1350 ft. deep and sinking is being continued.

No work has been done to determine the width of the ore on the 800-ft. level and it is only known that it is wider than the drift. The shoot entered 300 ft. south-east of the shaft on the first, or 165-ft., level proved to be 125 ft. long and a drift is being continued beyond it in a search for another shoot. The drift on the second level will be extended to prospect that on the first. Shipments to the Belmont mill at Tonopah continue at a rate of 50 tons of $30 ore daily. A pipe line is to be laid from

the Gold Reef shaft to the Tonopah Divide, which will eliminate the heavy expense of hauling water from Tonopah. The Gold Zone has shipped 15 to 20 tons of $15 to $20 ore from the 700-ft. level and the 150-ft. winze from the 500. The net return to the company was more than $10 per ton. This ore, thought to be in a vein distinct from the main ore-channel in the Tonopah Divide, is now believed to be the main Tonopah Divide vein, faulted. The Brougher has opened what is considered to be the most important ore-shoot found thus far. This find was made in a drift driven south-east, or toward the Tonopah Divide, from the 100-ft. point in a winze from the 500-ft. level. The ore has now been opened for nearly 50 ft. and the average value is reported to be $20 to $25. The winze is being continued to 1000 ft., where connection will be made with the Tonopah Divide.

ELY.—It is reported that a drill-hole being sunk 900 ft. east of the Star Pointer shaft of the Ruth mine of the Nevada Consolidated has been in 1 to 3% copper ore for 260 ft. below a depth of 710 ft. This is said to be a new find 200 ft. below the level of the bottom of the main working shaft.

GOLDFIELD.—The Florence has resumed work, the order coming at a time when it was expected the company would be idle much longer. It is understood the Eastern interests have furnished funds to complete the south-east cross-cut on the seventh level and prospect the vein. It is said there is now ample money available to do enough work to determine definitely whether there is ore in this vein. S. J. Connelly, representing the Portland company of Cripple Creek, is inspecting the air-compressors of the Consolidated with a view to purchasing one or more for his company, which is said to be preparing to sink to 3500 ft. from the present depth of 2500. The Consolidated has two of the largest electrically operated compressors in the country.

CARLIN.—The Lynn Big Six, operating a low-grade gold mine at Goldville, 20 miles north of here, is building a 100-ton amalgamating-concentrating mill. The company has opened, through an 800-ft. cross-cut tunnel at a depth of 100 ft., five veins 5 to 35 ft. wide, two of which have been prospected with drifts. There also is a 370-ft. inclined shaft with several hundred feet of drifts from it. Two 100-ton test-runs gave an extraction of 70% of the gold. At one point a winze has been sunk 110 ft. in low-grade ore. The formation consists of bedded rhyolite, intersected by dikes of rhyolite and porphyry. The gold is in a vein-filling of broken quartz and rhyolite striking parallel to the dikes. The Lynn Big Six is controlled by Utah men.

SIMON SILVER-LEAD MINE, NEAR MINA, NEVADA

STONEWALL.—A 32,000-gal. tank has been bought by the Yellow Tiger for the storage of oil in an effort to reduce costs. A new Waugh turbo drill using 1¼-in. round steel will be used when work is resumed in the tunnel and a steel-sharpening plant has been completed. The present work is confined to surface prospecting, but plans for raising additional money through the sale of treasury stock are "progressing nicely", according to Gordon M. Bettles, manager, and it is expected that work in the tunnel will be resumed in a short time. Mr. Bettles estimates that the tunnel will be in extremely hard porphyry for 200 or 300 ft. more.

CARSON.—Only eight men were killed underground and two on the surface in the Nevada mining industry during 1920, as against 16 last year and 26 in 1918, according to a report to be issued by Andrew J. Stinson, State Mine Inspector. The report will recommend more rigid examinations for hoist engineers and the issuance of licenses in three grades, according to the applicant's knowledge of hoisting-machinery. Physical examinations also will be recommended as compulsory for hoist engineers in the State.

UTAH

WAGES ARE REDUCED BY UTAH MINING COMPANIES.

Salt Lake City.—On December 14, the metal-mine operators of Utah announced that on January 1, wages of employees in all of the underground mines in the State would be reduced 75c. per shift. At present miners are receiving $5.25 and muckers $4.75 per shift, so the new rates will be $4.50 and $4.00, respectively. On December 17, R. C. Gemmell, general manager for the Utah Copper Co., announced that all skilled labor employed by the company would be reduced $1 per shift and unskilled labor 85c. About 2000 employees will be affected by this reduction at the Utah Copper properties alone. At the same time, Gemmell announced that operations would be suspended at the leaching-plant at Garfield, and that all construction work would be discontinued. This will result in several hundred men being laid off. During November the Utah Copper sold only 2,800,000 lb. of copper, as against a production of 9,120,000 lb.; during the first 11 days of December copper sales were but 900,000 lb. The average price obtained for the November sales was 14.85c. per pound, and for the December sales, 14c. per pound, whereas during the third quarter of the year it cost the company 17.156c. per pound to produce its copper; for several months past, the Utah Copper has been operating at a loss. Recent developments have rendered it necessary to make a still further curtailment in production, and the management feels that, so far as the employees are concerned, it is better to make a reduction in wages than to suspend operations entirely. There is now a surplus of labor in every mining camp in the State.

Eureka.—The Tintic Standard Mining Co. on December 11 declared a dividend of 20c. per share, which was paid on December 23. This disbursement totaled $234,940, and brings the grand total up to $1,429,962. E. J. Raddatz, president of the company, has announced that a new shaft, to be known as No. 3, will be sunk at a point about 1600 ft. to the north-east of the No. 2 shaft and within 100 ft. of the company's new railroad. It will be the largest shaft of the three, containing four compartments, being 6 by 18 ft. Machinery has already been purchased and the work will be rushed. Most of the company's output of ore is coming through the No. 2 shaft, and when the milling plant is in operation early in the new year, this shaft will be taxed to its capacity. About 450 mine-cars are now being hoisted daily through this shaft; the equipment is capable of handling 600 cars.

The United States Smelting Co., of Midvale, has taken a lease on part of the Dragon Consolidated mine. About 50 tons of iron ore is now being extracted by the smelting company daily, and this amount will shortly be increased to 100 tons. The Dragon company will receive a royalty of from 50 to 75c. per ton.

The Eagle & Blue Bell Mining Co. has posted a dividend of 10c. per share, to be paid out of earnings, and a dividend of 15c. per share, to be paid out of reserve for depletion, as return of capital, both payable on December 23. As there are 893,146 shares outstanding, this will call for the payment of $222,286, and bring this year's disbursements up to $311,605, a dividend of 10c. per share having been paid in April. The grand total to date of such disbursements is $1,562,009. The company is controlled by the Bingham Mines Co., and is one of the principal lead-silver producers in this district. A recent statement by Imer Pett, general manager, was to the effect that the property was never in better physical condition, and shipments could be greatly increased if it were not for the unsatisfactory condition of the lead market.

From present indications, the Chief Consolidated mine will break all records for metal output during the present year. During the first nine months the output of silver was 1,950,585 oz.; of gold, about 4000 oz.; and of lead, 9,499,119 lb. It is expected that the current quarter will result in the production of about 3,000,000 lb. of lead, whereas the total lead output for 1919 was 5,979,588 pounds.

Park City.—At a meeting of the directors of the Daly West Mining Co. on December 13 the regular quarterly dividend of 25c. per share was declared, payable December 24. This called for the payment of $62,500, and brings the grand total of such disbursements up to $6,831,000. At the same meeting, the directors of the Judge Mining & Smelting Co. voted to pass the dividend for the current quarter. S. G. Taylor, treasurer, issued a letter to the stockholders, stating that this action had been taken owing to the low market prices of metals, increased freight and smelter-rates, and excessive extraction costs. It was further stated that labor conditions show a decided improvement of late, but owing principally to metal-market conditions, the directors deemed it advisable to retain a substantial balance in the treasury.

The milling plant at the Glenallen property was completed on December 10 and operations were started on December 13. Within 30 days the flotation department, consisting of five Jones-Belmont machines, will be in operation. The mill has a capacity of 100 tons per day, although it is expected this tonnage can be built up to 225 tons per day. Tests indicate that a 90% extraction can be made on ore averaging 60c. in gold, 9 oz. silver, 9% lead, 16% zinc, 2% copper, and 14% iron. A lead-silver concentrate will be produced, while the zinc recovered will be stored until more favorable market conditions prevail. Originally the greater part of the Glenallen property was known as the Glencoe group. In 1893 the property was closed, and operated spasmodically without results until three years ago when the present company was organized. Some months ago J. S. Weeks of New York examined the mine, and it was on his recommendation that the milling plant was constructed. James B. Allen is general manager for the company.

Additional ore has been developed during the past few weeks at the Silver King Coalition, according to M. J. Dailey, mine manager. On the 1300-ft. level, a drift to the north-west from a cross-cut to the O'Brien zone, has opened a good face of ore in the same bedding in which the ore on the 1100-ft. level is found.

BRITISH COLUMBIA

DECISION IN LITIGATION OVER THE ENGINEER MINE.—CANADA COPPER CORPORATION SUSPENDS OPERATIONS AT ALLENBY.

VANCOUVER.—Justice Morrison rendered judgment on December 8, dismissing the claim of W. Pollard Grant, a lawyer of this city, for a one-fourth interest in the Engineer mine, at Atlin. The Engineer probably contains richer gold ore than any other mine in the Province. In the fall of 1918 the Mining Corporation of Canada sent two engineers to make an examination of the mine, but in returning from the property with James Alexander and his wife, the owners, they shared the fate of all the other passengers on the ill-fated 'Princess Sophia', which sank in the Lynn Canal in October of that year. Prior to this time Capt. Alexander had worked the mine in a desultory way for ten years, and from time to time had taken out some fabulously rich ore. The first-grade ore was crushed in a small jaw-crusher and pulverized in quantities of 600 to 1000 lb. in a five-foot ball-mill. Two or three flasks of mercury were then added, and the mill revolved slowly for 20 minutes. The amalgam was separated from the pulp by washing, and was treated in the usual way. On one occasion 160 lb. of ore yielded 296 oz. of gold. A great deal of open-cutting and surface stripping has been done, exposing altogether 25 veins, ranging in width from a few inches up to 275 ft. Tunnels have been driven on the more promising of these, but unless really rich ore was found the work was dropped. One bonanza shoot, 30 ft. long and varying from the thickness of a knife-blade to 18 in., has been stoped from the surface to 275 ft. In some of the pinched places the ore in this shoot contained more gold than quartz. At least two of the big Ontario silver mining concerns have their eyes on this mine, and it is likely that negotiations will be concluded this winter. Ben Nichol, who owns the claims adjoining the Engineer, has gone to Atlin to prepare for the development of his claims next spring.

PRINCETON.—After running it for 52 days, the Canada Copper Corporation closed its plant at Allenby on December 11; the mine was closed two days earlier. The corporation has made the following announcement: "Owing to the low price of copper, which has been gradually dropping, it has become necessary to close down the mine and plant at Copper Mountain and Allenby." Some time before closing, the company asked the men to accept a reduction of 50c. per shift in the wage-scale. After holding a number of meetings the majority refused this offer, and the directors ordered the closing of the plant. Some 400 men have been thrown out of work, about 60 of whom are married and have families. The single men have left for other places, but with the Britannia closed and Granby and Trail reducing their staffs, it is difficult to see where they will find work in this Province. Already about 1200 men have been laid off within the last two months by the copper companies of the Province.

TOOELE PLANT OF THE INTERNATIONAL SMELTER COMPANY

TRAIL.—Despite the downward trend of metal prices, the Consolidated M. & S. Co. is holding up the output of its mines. The closing of the Canada Copper, it is feared, may mean the closing of the copper-smelting and refining department at the smelter. The company has made large expenditures to take care of Canada Copper's concentrate. These include the erection of three sintering furnaces, and the practical doubling of the capacity of the whole copper-treating plant. The power-line, too, to Copper Mountain was erected by a subsidiary company. Rossland Velvet Mines, Ltd., has been incorporated at Rossland with a capital of $300,000 to take over and operate the Velvet mine. The Velvet was re-opened this year and has shipped 310 tons to the smelter. The Exchequer and Athabasca groups, on Toad mountain, two and a half miles from Nelson, have been purchased by the owners of the California group, in the same district. There is a 10-stamp mill, cyanide plant, compressor, and power-plant on the Athabasca.

ALICE ARM.—A good body of ore assaying 300 oz.

silver per ton has been found at the North Star mine. Ten horses have been taken to the mine, and will be employed during the winter in hauling ore to the Dolly Varden railway, where it will be stored until the spring. It is expected that 15,000 to 20,000 tons of ore will be taken out during the winter. A full force of men will be employed throughout the winter. E. W. McQuade, superintendent of the Moose mine, reports that development work is progressing well. During the last month the lower tunnel has been advanced 45 ft. and the upper one 36 ft.; the latter is being driven on a six-foot lode of good ore. The new owner of the Alice Arm hotel has made arrangements to commence enlargements and improvements to the hostlery at the beginning of the year. This will be a great boon to the many mining men who visit the district.

ONTARIO

WRIGHT-HARGREAVES MILL-CONSTRUCTION IS PROGRESSING.

Cobalt.—Labor is abundant but wages remain unchanged. The McKinley-Darragh and the Mining Corporation have reduced their staffs, but are still producing at about two-thirds capacity. During November the Nipissing mine produced $190,219, as compared with $184,578 in October. The November output is valued on a basis of silver at 69c. per ounce, as compared with 82c. in the preceding month. In his report to the president and directors, Hugh Park, manager, states: "No new veins were opened during the month. Production was obtained from the older stopes, assisted to some extent by development work being done on several small veins on both sides of the lake. The low-grade mill treated 6000 tons. The high-grade plant treated 192 tons. The refinery shipped 250,067 fine ounces of silver." On January 20 the Nipissing will disburse a dividend of 5%, as well as a bonus of 5%, making a total distribution of $600,000. A statement just issued by the Ontario Bureau of Mines, covering the first nine months of 1920, shows a silver output of 7,831,143 oz., valued at $8,435,088, in 1920, as compared with 7,475,396 oz., valued at $7,898,220, in the corresponding period of 1919, the increase amounting to $536,868. The Nipissing continues to be the heaviest producer, with the Mining Corporation holding second place.

Porcupine.—A dividend of 1%, declared by the Hollinger Consolidated, payable December 31, is the ninth to be paid this year, making total disbursements of $2,214,000. Coal is being rushed to the mine so as to keep the auxiliary steam-plant in full operation. Production for the current year with the mill working at an average of about two-thirds capacity, will approximate six million dollars.

At the McIntyre the ore-reserves are being rapidly increased by the development of the new vein-system, lying about 400 ft. south of No. 5 shaft, where results have exceeded expectations. On the 1375-ft. level the new vein shows a width of about 20 ft. with high gold content. The mill is running at capacity with an improvement in the grade of ore being treated.

Kirkland Lake.—Preparations are being made at the Wright-Hargreaves for the opening of the new mill early in the new year. The mine is in good condition to keep the mill steadily supplied with ore. Most of the ore developed is on the 400-ft. level and is high in grade. The workings of the central shaft are being connected with those of the North shaft, through which the ore will be handled. Stations are being opened up at the 100, 200, and 300-ft. levels preparatory to undertaking lateral work. The main ore-shoot, which has been followed up for 400 ft., has a width of 20 feet.

Larder Lake.—Diamond-drilling has been carried on by the Associated Goldfields. About 40 holes have been sunk, many of them between 700 and 1000 ft. in depth. The majority have been directed to explore the broad gold-bearing belt extending through the Kerr-Addison and Reddick properties. Ten thousand feet more of diamond-drilling remains to be done on the present contract. The work has been stopped, to be resumed in the spring.

MEXICO

EXPORT DUTIES ON COPPER WAIVED.

Agua Prieta.—Material for the construction of a railroad from Naco, Sonora, by way of Agua Prieta, to Guzman, Chihuahua, connecting there with the Mexico Northwestern, is arriving at Agua Prieta. The material assembled here is shipped from Eagle Pass, Texas, is all new, and is sufficient to equip 1000 men. J. J. Slade, an American engineer, is in charge of construction.

Until the price of copper goes to more than 15c. on the New York stock market, export duties on shipments of ore and copper from Mexico into the United States have been removed by the Mexican government. The order is retroactive to December 1, and indicates that duties paid subsequent to that date will be returned to the companies. This action is taken as an effort to cope with the general depression in the copper market, in the hope that copper companies operating in Mexico will not be forced to suspend operations.

Nacozari.—The Moctezuma Copper Co., a branch of the Phelps Dodge Corporation, will not close-down but will continue operations on a restricted scale, according to P. G. Beckett, general manager for the Phelps Dodge Corporation. Mr. Beckett said that the waiving by the Mexican government of the export duty on copper would help, but that it will not result in an immediate increase in the scale of operations.

Cananea.—The Cananea Consolidated Copper Co. will suspend operations on January 15, 1921, as was announced a few weeks ago, in spite of the removal of the export duty on copper and copper ores, according to reports. Adolfo de la Huerta, minister of the treasury, and General P. Elias Calles will arrive at Nogales before January 15 to use their offices in an effort to adjust the difficulties of the company and to avert the shut-down. It is estimated that suspension of operations by the company would affect about 20,000 persons, directly or indirectly.

ARIZONA

Kingman.—The Tennessee and Schuylkill mines of Chloride have gone into receivership, George N. MacBean, of Holbrook, Arizona, having been appointed receiver. Frank A. Garbutt, of Los Angeles, California, it is reported, holds a mortgage of $300,000 on the property.——The drift from the 420-ft. level of the Diamond Joe mine is said to have cut ore 30 in. wide, which will run as high as 100 oz. in silver per ton besides some lead.——Connection has been made in the drifts being run by the Tom Reed and the United American at Oatman. This connection is on the 400-ft. level of the Tom Reed. The Tom Reed drift was run in ore for 300 ft. prior to holing through. This ore carries visible free gold and is reported to be of high grade. In all, the ore-shoot is said to be over 500 ft. long, 200 ft. being in United American ground.

CALIFORNIA

Amador County.—Unwatering of the Argonaut and Kennedy mines is proceeding rapidly. The pumps on the lower levels that were flooded by the advancing waters have been recovered and found in excellent condition, and are aiding the main pumping plant in clearing the deeper workings. The shafts and drifts thus far unwatered have been found in excellent shape, and will require little in the way of repairs. The work is being carried on at both properties at the expense of the Argonaut company, which is anxious to reach an approximate depth of 4800 ft. where a large body of rich ore is exposed.

Conditions at Sutter Creek show steady improvement despite the many handicaps affecting gold mining. The Central Eureka continues to develop excellent ore on the 3900-ft. level, and is maintaining heavy shipments of profitable ore to the mill. In the Old Eureka recent work has exposed promising ore in new territory.

Operations have been resumed at the Fremont Consolidated, near Amador City, after an idleness of two years. The Gover shaft has been completely unwatered and large areas of the Fremont shaft also cleared, with good ore reported in sight at several points. The property is now controlled by a new coterie of owners, with Edwin Higgins manager. A few years ago the property ranked high among the leading dividend-disbursers of the Mother Lode region.

Nevada County.—According to reports new rich ore-shoots have been uncovered in the bottom levels of the Empire and Pennsylvania mines of the Empire Mines Co. The company is operating its 80-stamp mill at full capacity and its monthly output is estimated at close to $100,000. Within the past six weeks the company has materially increased its working force and started development of new territory.

IDAHO

Bonners Ferry.—Twenty-four men are working for the Cyanide Gold Mining Co., 25 miles north-east of here. Each man is paid $1 per day and takes the rest of his wages in stock in the company. "All the men are doing this and are glad to do so, in fact, some of them put the dollar they receive back in additional stock," said J. B. Ellis, president of the company. "We are installing a mill, tram, and power-plant, and as soon as the tram is completed we will commence operation of the mill."

Coeur d'Alene.—C. A. Gray, secretary of the International Mining & Metal Co., says that the drift now being driven to the west of the vein is 30 ft. from the end of the 300-ft. tunnel. The property is developed to a depth of 260 ft. by a 300-ft. tunnel and an 11-ft. winze. Ore from this winze and tunnel assayed 2% copper, 27% zinc, 24% lead, and 9 oz. silver.——The U. S. Silver-Lead Mining Co. reports that a seven-foot vein has been cut with 1½ ft. of high-grade shipping ore. Drifting is being done to determine the extent. In the tunnel, 125 ft. above, the ore-shoot was 350 ft. long. ——Better zinc-lead ore is found on the No. 10 level of the Callahan Zinc-Lead mine than was found on the No. 9 level, 200 ft. above. This seems to disprove the fear that the zinc ores of the district would not persist with depth. Although the mill of the company is closed and no ore is being mined, development work continues. The vein on the No. 10 level is four feet wide. When the extent of the orebody is determined the shaft will be sunk 200 ft. farther.——According to reports, the United States Supreme Court has denied the application for a writ of certiorari asked by the Federal Mining & Smelting Co. against the Star Mining Co., involving title to the Star-Morning vein at Mullan. This means that the Star mine obtains title to the valuable vein west of the Morning end-lines. In addition, there is an accounting to be made of ore extracted by the Federal company from that part of the vein. This is expected to bring the Star owners between $500,000 and $1,000,000. The Star mine is now under option to the Bunker Hill & Sullivan Mining & Smelting Co. for approximately three-quarters of a million dollars, subject to the decision of the Supreme Court. Awaiting the decision, no work has been done recently.

NEVADA

Good Springs.—The Yellow Pine Mining Co. closed its mines and mills, owing to the low prices of lead and zinc. Some weeks ago, the company considered such action, and the miners and millmen accepted a cut in wages in order to keep things going, but as metal prices continued to decline, there was no alternative but to suspend operations.

OREGON

Gold Hill.—Charles A. Knight, who three years ago acquired the Millionaire gold mine, an old-time producer, situated three miles east of Gold Hill in the Blackwell Hill district, is preparing to resume operations. He has spent a large sum of money in re-opening the old works, re-building the shaft-houses, remodeling the mill, and re-building the electric power-line to the mine, which was dismantled early in the war period. The mill has two 1500-lb. Nissen stamps with circular discharge and two 10-ft. amalgamating plates; it has a rock-crusher and a Standard concentrating table.——Among the large hydraulic placer properties which control large flows of water and are not affected by dry seasons is the Sterling mine, in the Jacksonville district, controlled by R. S. Bullis, of Medford. A large electric-power pump has recently been added to the equipment, by means of which pressure at the nozzle has been increased to the equivalent of a head of 200 ft. The gravel is so thoroughly cemented that much of it must be broken with powder before using the giants. The deposit is 20 to 40 ft. thick and about 400 ft. wide. The slope of the bed is about 2 ft. in 100. The

value of the gravel is about 40c. per cu. yd., and the total production of the mine is said to exceed $3,000,000. The length of the working season varies from 7 to 10 months.

Waldo.—The Esterly mine, generally known as the Logan placer, is owned and operated by George M. Esterly and associates of Seattle. Forty miles of ditches carry water from the higher portions of the east and west branches of the Illinois river to supply the mine. The head is 325 ft. The gold is generally fine, running about 15c. per cubic yard; it is accompanied by some platinum, as well as a little osmium and iridium. The output of this mine is about $60,000 annually. The area mined varies greatly in width, averaging an eight of a mile. Formerly a hydraulic elevator was used to remove the tailing from the pit, with a lift of a maximum of 15 ft., but recently a tail-race tunneled through solid rock at a cost of $60,000 has been completed which will double the output of the mine. The other important hydraulic placer mines in the Waldo district are the Deep Gravel or Wimer mine, and the High Gravel or Osgood mine.

WASHINGTON

Pullman.—A 12-weeks special course in mining, geology, assaying, ore-testing, metallurgy, mineralogy, and mine-surveying, offered by the School of Mines and Geology of the Washington State College, is to begin January 3, 1921. The course is designed for men interested in mining but who have not had the advantage of special college training and is open to all over 21 who can read and write and who are able to do ordinary arithmetical problems. In the assaying course a deposit of $25 is required of each student, partly to defray the cost of fuel, fluxes, and chemicals. Otherwise the expense to the student is the cost of a few books and his living. The instruction is of a laboratory character, the student being taught by doing or observing the things he is learning. The use of the lecture-room is largely confined to the description and illustration of the best methods and practices in mining and metallurgy. In addition to an excellent corps of instructors the school equipment gives the student the best facilities for work. In the mining building is machinery for sampling, amalgamating, concentration, cyaniding, smelting, and a complete flotation-testing laboratory.

WYOMING

Cokeville.—Several years ago W. A. McKinney of Salt Lake City and associates acquired some mining property 30 miles north-east of here, consisting of 25 claims, now in the process of patenting, and a mill-site on Smith's fork of Bear river. This property was discovered nearly 30 years ago, but on account of its inaccessibility, practically no work has been done. Recently high-grade ore has been found in No. 4 tunnel level, which has been driven 600 ft. for the purpose of cutting the main lode at a vertical depth of 400 ft. below the tunnel above.

MANITOBA

Flin Flon.—The Federal government has agreed to waive all royalties on copper for five years. It is believed that this will have an important effect on the operations of the Flin Flon syndicate. The initial payment of $1,000,000 will fall due on March 1, 1921, and provided those now exploring the property receive an assurance that a railway will follow the present surveys within a reasonable time, in all likelihood the purchase will be made. The mineral resources of the three prairie provinces, Manitoba, Saskatchewan, and Alberta, belong, as yet, to the Federal government, and this has complicated matters. There may be a change before many months, and then the negotiations with the Flin Flon interests will come under the sole purview of the Manitoba government, which is understood to be most anxious to assist in the building of a smelting centre north of the Saskatchewan.

PERSONAL

The Editor invites members of the profession to send particulars of their work and appointments. The information is interesting to our readers.

S. M. Parker, of Nicaragua, is in San Francisco.

D. M. Riordan has returned from New York to San Francisco.

Frank M. Smith has returned from Los Angeles to Spokane.

Ellsworth Daggett, of Salt Lake City, is sojourning in San Francisco during the winter.

C. C. Broadwater, of the Merrill Company, San Francisco, has returned from London and Paris.

L. S. Cates, general manager for the Ray Consolidated Copper Co., was in San Francisco last week.

C. W. Purington expected to leave Shanghai on December 10, on his return from Eastern Siberia to London.

G. E. Drewitt has accepted the position of manager for the Federal Coals, Ltd., at Lethbridge, in Alberta, Canada.

L. D. Ricketts is a visitor in the Warren district attending to matters connected with the Calumet & Arizona Mining Co.

Walter R. Vidler has returned to Los Angeles, having completed a month's examination work near Culiacan, Mexico.

Morton Webber is at the Empire mine, at Mackay, Idaho. He spent several days in Salt Lake City on his way from New York.

C. B. Lakenan, general manager for the Nevada Consolidated Copper Co. at McGill, Nevada, spent a few days at Salt Lake City recently.

D. C. Jackling left New York on December 17 for the West. He spent two days at Salt Lake City and arrived in San Francisco on the 23rd.

Alexander Mackay, president, and **F. S. Stephen,** director, of the Dundee-Arizona, are visiting the company's property at Jerome, from their home in Scotland.

Frank P. Knight, president of the Iron Cap Copper Co., and **J. Judson Dean,** vice-president, are visiting the properties of the company in the Globe district.

B. Shutts and **H. E. Hecker,** officials of the American Ores & Asbestos Co., have recently inspected the properties of the Shaff-Regelman properties at Crysotile, Arizona.

F. A. Malins has been appointed consulting metallurgist to the Dos Estrellas Mining Co., El Oro, Mexico. **W. B. Rhodes** succeeds him as superintendent of the El Cedro mill.

Russell G. Lucas, of the legal firm of Dickson, Ellis, Lucas & Adamson, Salt Lake City, has accepted a position with the Utah Copper Co. in charge of the industrial relations department.

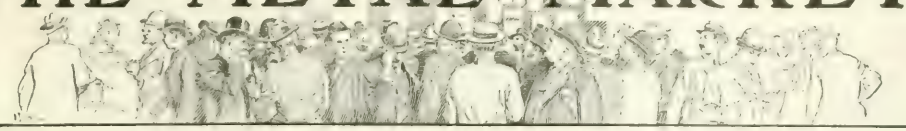
Arthur H. P. Moline, general manager for the Bendigo Amalgamated Goldfields, at Bendigo, Victoria, is visiting representative mines in California, Utah, and Colorado. He is at Salt Lake City now.

Arthur C. James and **William C. Osborn,** directors of the Phelps Dodge Corporation, in company with **Walter Douglas** and **P. G. Beckett,** have been visiting the properties of the Phelps Dodge in the South-West.

R. S. Lewis, head of the Department of Mining and Metallurgy in the University of Utah, has been granted a year's leave of absence. He will spend that period in field study of mining and in preparing a course of lectures on coal mining.

A. G. Mackenzie, secretary of the Utah chapter of the American Mining Congress, is at Chicago attending the hearing before the Western Trunk committee, regarding a reduction in freight-rate on bullion from Western smelters to the Atlantic seaboard. **George E. Collins,** governor of the Colorado chapter of the Congress, is also in attendance.

THE METAL MARKET



METAL PRICES

San Francisco, December 21

Aluminum dust, cents per pound	65
Antimony, cents per pound	9.50
Copper, electrolytic, cents per pound	14.00—14.50
Lead, pig, cents per pound	5.75
Platinum, pure, per ounce	$85
Platinum, 10% iridium, per ounce	$125
Quicksilver, per flask of 75 lb.	$50
Spelter, cents per pound	9.50
Zinc dust, cents per pound	12.50—14.00

EASTERN METAL MARKET

(By wire from New York)

December 20.—Copper is inactive but easy. Lead is dull and lower. Zinc is quiet and declining.

SILVER

Below are given official or ticker quotations for silver in the open market as distinguished from the fixed price obtainable for metal produced, smelted, and refined exclusively within the United States. Under the terms of the Pittman Act such silver will be purchased by the United States Mint at $1 per ounce, subject to certain small charges which vary slightly but amount to approximately three-eighths of one cent. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the normal rate of exchange.

Date	New York cents	London pence
Dec. 14	62.25	40.62
" 15	66.00	42.62
" 16	64.75	41.87
" 17	64.00	41.00
" 18	63.62	41.00
" 19 Sunday		
" 20	62.00	40.00

Average week ending	Cents	Pence
Nov. 8	71.90	54.00
" 15	80.02	53.50
" 22	76.41	49.96
" 29	73.72	48.97
Dec. 6	69.08	44.29
" 13	62.54	41.06
" 20	63.77	41.18

Monthly averages

	1918	1919	1920
Jan.	88.72	101.12	132.77
Feb.	85.79	101.12	131.27
Mch.	88.11	101.12	125.70
Apr.	95.35	101.12	119.56
May	99.50	107.23	102.69
June	99.50	110.50	90.84
July	99.62	106.36	92.04
Aug.	100.31	111.35	96.23
Sept.	101.12	113.92	93.66
Oct.	101.12	119.10	83.48
Nov.	101.12	127.57	77.73
Dec.	101.12	131.92	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date	
Dec. 14	14.00
" 15	14.00
" 16	13.75
" 17	13.50
" 18	13.50
" 19 Sunday	
" 20	13.50

Average week ending	
Nov. 8	15.00
" 15	14.87
" 22	14.62
" 29	14.15
Dec. 6	13.63
" 13	14.00
" 20	13.71

Monthly averages

	1918	1919	1920
Jan.	23.50	20.43	19.25
Feb.	23.50	17.34	19.05
Mch.	23.50	15.05	18.49
Apr.	23.50	15.23	19.23
May	23.50	15.91	19.05
June	23.50	17.53	19.00
July	26.00	20.82	19.00
Aug.	26.00	22.51	19.00
Sept.	26.00	22.10	18.75
Oct.	26.00	21.66	16.53
Nov.	26.00	20.45	14.63
Dec.	26.00	18.55	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date	
Dec. 14	5.00
" 15	4.90
" 16	4.75
" 17	4.75
" 18	4.75
" 19 Sunday	
" 20	4.75

Average week ending	
Nov. 8	6.84
" 15	6.61
" 22	6.44
" 29	5.67
Dec. 6	5.24
" 13	5.00
" 20	4.82

Monthly averages

	1918	1919	1920
Jan.	6.85	5.60	8.65
Feb.	7.70	5.13	8.88
Mch.	7.26	5.24	9.22
Apr.	6.99	5.05	8.78
May	6.99	5.04	8.55
June	7.59	5.32	8.43
July	8.03	5.53	8.63
Aug.	8.05	5.78	9.03
Sept.	8.05	6.02	8.08
Oct.	8.05	6.40	7.28
Nov.	8.05	6.76	6.37
Dec.	6.90	7.12	....

TIN

Prices in New York, in cents per pound

Monthly averages

	1918	1919	1920
Jan.	85.13	71.50	62.74
Feb.	85.00	72.44	59.87
Mch.	85.00	72.50	61.92
Apr.	88.53	72.50	62.17
May	100.01	72.50	54.99
June	91.00	71.83	48.33
July	93.00	70.11	49.29
Aug.	91.33	62.20	47.60
Sept.	80.40	55.79	44.43
Oct.	78.82	54.82	40.47
Nov.	73.67	54.17	36.97
Dec.	71.52	54.94	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date	
Dec. 14	6.00
" 15	5.90
" 16	5.90
" 17	5.90
" 18	5.85
" 19 Sunday	
" 20	5.80

Average week ending	
Nov. 8	7.31
" 15	6.86
" 22	6.66
" 29	6.25
Dec. 6	6.14
" 13	6.42
" 20	5.89

Monthly averages

	1918	1919	1920
Jan.	7.78	7.44	9.56
Feb.	7.97	6.71	9.15
Mch.	7.67	6.53	8.93
Apr.	7.04	6.49	8.76
May	7.92	6.43	8.07
June	7.92	6.91	7.92
July	8.72	7.78	8.18
Aug.	8.78	7.81	8.31
Sept.	9.58	7.57	7.84
Oct.	9.11	7.82	7.50
Nov.	8.75	8.12	6.78
Dec.	8.49	8.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds.

Date	
Nov. 23	55.00
" 30	55.00
Dec. 7	55.00
" 14	55.00
" 21	50.00

Monthly averages

	1918	1919	1920
Jan.	128.06	103.75	89.00
Feb.	118.00	90.00	81.00
Mch.	112.00	72.80	87.00
Apr.	115.00	73.12	100.00
May	110.00	84.80	87.00
June	112.00	94.40	85.00
July	120.00	100.00	88.00
Aug.	120.00	103.00	85.00
Sept.	120.00	102.60	75.00
Oct.	120.00	86.00	71.00
Nov.	120.00	78.00	56.00
Dec.	115.00	95.00	....

CHARLES M. SCHWAB ON ECONOMIC CONDITIONS

Speaking as president of the Pennsylvania Society of New York, at the annual dinner of the society, at the Waldorf-Astoria, Charles M. Schwab said, in part:

"The existing moment is full of difficulties and complexities. Here and there you find prophets of despair. But I want to go on record here as saying that nothing could be healthier for American business than the very condition through which we are now passing. It had to come. I only wish it had come sooner. The severer the storm is now, the quicker it will be over and the sooner we can emerge into clear weather and shape our course upon the sea of prosperity. Business in the United States ever since the War started had been, until very recently, upon a false basis. The disposition of many manufacturers had been to say not: 'Let me see your costs sheet,' but 'Let me see your statement of profits'.

"The result of this experience through which we have passed is that our costs have been inflated and we have had in America both our business institutions and American individuals generally indulging in wasteful and extravagant methods. The supreme virtue of the existing situation is that it is compelling every business man in America, in fact, every individual in America to examine thoroughly his costs of doing business and his costs of living. The result of it all is to force business and to force individuals to start to economize and to save.

"The great need of the world today is to work hard and save. This applies not alone to the laboring man, but to the man of great means. There is no place in America today for the loafer. I hear men say that the greatest need of the hour is the liquidation of labor. In saying this many have in mind the high wages now being paid to labor and industry, and mean that labor must adjust itself to a new standard of living. Now, the laboring man is primarily interested not in the amount of money paid to him, but what his money will buy. If the cost of living comes down there is no question that our American laboring man can maintain his present standard of living even though his wages as stated in dollars amount to a lesser sum than before.

"In the steel industry one-half the total cost of making steel is the cost of labor. You can, therefore, see how important efficiency and labor costs are in all items of manufacture. The laboring man is entitled to his full share for the contribution he makes to the value of an article. The laboring man should be taken into the fullest confidence of his employers. He should be so sure of getting his just share of the wealth he produces that he will work with zeal and enthusiasm.

"Certain it is that unless the great body of men throughout the world work with might and main to restore that which has been lost by the destructiveness of war, this world will sink to a lower level of civilization than we have been accustomed to enjoy. Certain it is, too, that labor must work as it has never worked before if it is to produce a sufficient quantity of goods to make possible the standard of wages which have been enjoyed [illegible] of inflation are of supreme necessity. Not merely increased production, but increased efficiency in production is essential. We are getting relieved of the impurities in our business life. The process is not complete yet. It may take some little time longer. But the patient will in time be cured and when he is cured the great body of American business will emerge with a vigor and an energy the world has never known before."

MONEY AND EXCHANGE

Foreign quotations on December 21 are as follows:

Sterling, dollars	Cable	3.53¾
	Demand	3.54¼
France, cents	Cable	6.04
	Demand	6.05
Lire, cents	Demand	3.55
Marks, cents		1.45

Eastern Metal Market

New York, December 15.

There is no animation to any of the markets, the price tendency in most cases being steady.

The copper market is very quiet and prices are steady.

Buying of tin is very light. Prices generally follow the ups and downs of the London market.

The lead market is steady with a fair amount of buying.

The zinc market has lost some of its recent strength and is lower.

Antimony has declined with the silver market.

IRON AND STEEL

The slowing down of business is more pronounced at many steel plants and the problems of cost reduction are uppermost, says 'The Iron Age'. Work is being rearranged to save the overtime resulting from the basic 8-hour day. Reductions in wages amounting to 15% and in some cases more will be made on January 1 by some important independent companies. Eight-hour turns are being introduced in some cases in order to give more men work, but because of scant orders there are only two shifts instead of three.

There are some reports of wage-reductions already made at some plants and one case of an offer by employees to cooperate in plans for reducing labor-cost.

There is sharper contrast between the Steel Corporation's rate of operations and the average rate at independent mills. The Steel Corporation increased this week to 90% of steelworks capacity and added a blast-furnace at Edgar Thomson and another at Gary. At the same time a further curtailment of output has been made at various Ohio and Pennsylvania independent works and more merchant blast-furnaces are stopping, especially in Virginia and eastern Pennsylvania.

Taking the country's steel capacity in its entirety, probably 65 to 70% is active this week. This is expected to be reduced next week and through the holidays more mills will be idle than at any time since the holidays of 1914-'15.

The world-wide recession is accented by further shipyard cancellations in Great Britain, including four 10,000-ton boats for Belgium. Due partly to the coal strike, November pig-iron production in Great Britain was 403,000 tons, compared with 692,200 tons average for the other 10 months of 1920, and the steel output for the month at 403,800 tons compares with a 10-months average of 780,500 tons.

COPPER

The market is quite steady but without feature or animation. Buying by domestic consumers is at a standstill and quotations are largely nominal at 14c., New York, for early delivery and 14.25c. for first quarter. There is a fair business being done in foreign sales, all for early delivery, indicating low stocks in Europe and other countries. No improvement in the domestic situation is expected this year, but some revival of buying is looked for in January.

TIN

Press and private advices yesterday were that the Malay government had advanced its minimum price from an equivalent of £226 per ton, c.i.f. New York, to £243 and this has, for the time being, upset the market. Spot Straits yesterday was variously quoted at 32.50 to 33.50c., New York, against 33.50c. on Monday. There was considerable activity on the New York Metal Exchange yesterday when 100 tons was sold. Of this 75 tons for future shipment went at 34.25 to 35c., while one lot of 25 tons was sold under the rule at 30c., a ridiculously low price. On the 8th a 25-ton lot was sold under the rule at 35.62½c. There was a fairly active business on December 8 when dealers bought quite freely of future shipments, December-January, at 37c. Aside from these developments the market has been quiet. The decline in silver has led to the appearance of some Chinese tin which sold on December 8 at 34.50c. for December shipment. Arrivals thus far this month have been 1575 tons with 2450 tons afloat. The London market is lower with spot standard at £212 10s., future standard at £216, and spot Straits at £213 10s., all about £11 lower than a week ago yesterday.

LEAD

Since the market settled to the 5c. level, both New York and St. Louis, there has been some good buying but it has not been animated. There has lately developed a weakness in London which has again foreshadowed the possibility of further imports which has put a damper on the market. It is now exceedingly quiet and a little lower at St. Louis. We quote the market for early delivery at 5c., New York, or 4.75c., St. Louis. The London market yesterday declined £23 per ton for prompt delivery and any further recession is likely to cause weakness here and lower prices, because of importing competition possible at 5c.

ZINC

After a brief period of animation and higher prices the market for prime Western has again declined, due largely to a weaker London market and the consequent possibility of imports. Prime Western for early delivery is now quoted at 5.90c., St. Louis, or 6 to 6.10c., New York, the latter being influenced by imported metal still available. There is almost no demand. Stocks in the hands of producers have slightly increased according to the November statistics, but the recent buying has brought out the fact that consumers' stocks are very low. The technical position of the market is considered favorable.

ANTIMONY

Largely in sympathy with the lower values for silver, antimony is easy with wholesale lots for early delivery quoted at 5.50c., New York, duty paid.

ALUMINUM

The leading interest's quotation for virgin metal, 98 to 99% pure, has not been lowered as reported, but continues at 32.90c. f.o.b. producer's plant. Other sellers are quoting the same grade at 23 to 25c., New York.

ORES

Tungsten: The market is stagnant and prices are nominal at $4 per unit for Chinese ore and $5 for Bolivian.

Ferro-tungsten is quoted at 59c. per pound of contained tungsten in a quiet market.

Molybdenum: There are no developments nor demand and quotations are nominal at about 65c. per pound of MoS_2 in regular concentrates.

Manganese: High-grade ore is unchanged at a nominal quotation of 42 to 50c. per unit, seaboard, in the absence of any demand. Imports are heavy and stocks are larger.

Manganese-Iron Alloys: There is a complete absence of any demand for ferro-manganese and it is difficult to state at what price it can be bought. As low as $140, seaboard basis, can certainly be done and perhaps lower. Spiegeleisen, 19 to 22%, is down to $60, furnace, at which 100 tons has been sold. Inquiries are limited to one or two carload lots.

Continued offerings by the Bank of France, combined with extremely poor trade conditions in China and India, as well as speculative activity, have been responsible for a further decline in silver.

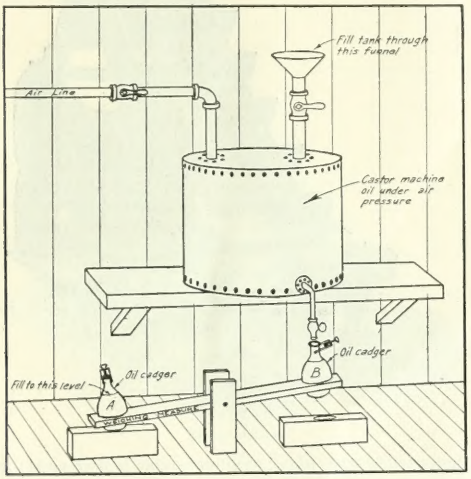
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

NORTH STAR MINE HAS INTERESTING DEVICE FOR FILLING OIL-CADGERS

By K. O. Duncan

One of the chief causes for the deterioration of rock-drills, causing unnecessary losses of both time and oil, is the indifference of mine managers to the methods employed for lubrication of the drills. In many mines where this important matter is left to the judgment of the miner, we find underground, tomato-cans, beer-bottles, whiskey-flasks, and other equally disreputable rock-drill oil-containers; none of them being well adapted to either filling or emptying without waste of oil and time; all inviting contamination from grit because of the inevitable uncovered condition of such containers; and all subject to destruction early in the shift because of their careless distribution about the place of action.



Device for Filling Oil-Cadgers

These common evils have been overcome to a large extent in the North Star mine at Grass Valley, California, by the use of the Donnelley oil-cadgers, a seemingly indestructible pocket oil-container of one pint capacity. It has a screw top and fits comfortably into the hip pocket of the miner.

Having adopted these containers, the management found that the filling of one hundred of them for each shift with the slow-moving castor machine-oil, was a tedious process. It was also found that there was wise economy in putting in each cadger only the amount of oil required for one drill during a shift. For the Waugh turbro drills it was found desirable nearly to fill the cadger, while for the Clippers, less oil was required for the shift's work.

To quickly and accurately place in the cadgers the precise quantity of lubricant for the particular drill in service, the simple but ingenious device shown in the accompanying sketch was constructed.

The air-pressure on the oil of course, speeds the filling. In practice two racks or boxes, each holding about fifty cadgers, are found convenient. For gauging the desired quantity of oil for the container, the operator has two cadgers, one filled for the needs of the larger drills and the other suited exactly to the lighter machines, these constituting the counter-weights that exactly apportion to each drill, a sufficient quantity of oil. The racks containing the filled cadgers are placed at the collar of the shaft, and each miner going to work takes one, returning the empty flask to the rack when coming off shift. This scheme at the North Star mine has effected a considerable saving in oil consumption and drill maintenance.

FLOTATION OILS

One of the vital factors on which the successful operation of a flotation plant depends, is the oils. If, for any reason, the correct oils are not being employed unsatisfactory results are bound to be obtained. Many adjustments and slight changes in operation can be made to take care of many of the minor troubles that are encountered from time to time in the plant. Unfortunately, however, such procedure will not correct unsatisfactory results that are caused by the use of incorrect or inferior oils. Since the inception of flotation in the United States, the Barrett Co. has been directing the efforts of its highly trained technical staff to produce high-grade uniform flotation oils. With this end in view, the company has spared neither time nor money to keep its flotation oils uniform and of such a character as will ensure the consumer's obtaining the highest metallurgical results.

The Barrett Co. is in an excellent position to carry on this important work for the mining industry. As is well known, the crude tars from the different tar-producing plants vary in characteristics to a greater or lesser extent. The variations are due to the conditions under which the tars themselves are produced, such as speed and temperature of coking, type of retort used, kind of coal employed, etc. All finished Barrett products are required to conform to rigid specifications. In order that these finished products can be made to do this, it is necessary that all of the raw materials be so blended as to give a uniform material before manufacturing is commenced.

This preliminary blending before manufacture requires large storage capacity and, also, many and constant sources of supply of raw tars. In all plants that produce blended flotation oils, both storage capacity and source of supply are necessarily provided in order to maintain flotation oils or products at the required grade and composition at all times, regardless of any slight variations that may be encountered in the raw tars that are employed. The metallurgical engineer, or flotation-plant operator, readily understands and appreciates the importance of this feature. The many causes of variation in flotation, other than the oils themselves, encountered in the daily plant operation, are so numerous and often so difficult of location, that the elimi-

nation of as many as possible of these variations in results due to the oils should have a great attraction for the user. At the present time the Barrett Co. is supplying various flotation reagents, including coal tars, coal-tar oils, fractions, and combinations of fractions of coal tar, as well as coal-tar chemicals, such as alpha napthylamine, xylidine, ortho-toluidine, etc. All of these materials have proved of exceptional merit under specific conditions to which they are adapted.

A number of mines have used crude coal tar and have had varying results, due, of course, to the great differences between tar from sundry sources and even between tars from the same sources at different times. Crude tar varies in viscosity and other physical properties, and in order that a mine may duplicate the results obtained from an initial lot of tar, a specially refined flotation tar should be employed.

A great advantage from the use of so-called 'specification' oils is the fact that each shipment is as nearly like every other lot as it is possible for science and care to make them. This fact tends to eliminate entirely all irregularities in plant operation due to oils, and is bound to make possible more even results than can be obtained with the less refined products. Recently great interest has been aroused among flotation engineers and operators by the success that has been obtained by the use of X-cake mixture (a mixture of 60% alpha napthylamine and 40% xylidine) in the plants of various large mining companies. The Barrett Co. is equipped to produce and furnish either crude or refined alpha napthylamine and xylidine separately, and small parcels of the different grades can be shipped for experimental investigation. Most mining companies, however, prefer to purchase alpha napthylamine and xylidine already mixed in portions of 60% and 40% respectively, thus eliminating the trouble of mixing them on the ground.

Many engineers and operators are of the opinion that there are certain fields and conditions where coal-tar oils and products cannot be used. Very thorough investigations have demonstrated, however, that this is seldom the case, and that coal-tar oils and products can replace other oils in most cases. The only manner in which this point can be practically demonstrated is by commercial tests in the operating plant. Barrel samples of flotation oils should be obtained and used, under operating conditions, before a question of this importance should be considered closed by the plant management.

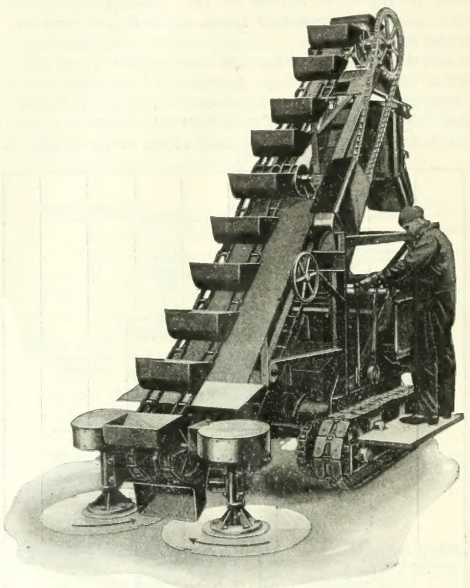
In order to get in closer touch with the users of flotation oils and products, the Barrett Co. has a flotation-oil department. This department is in charge of a thoroughly competent flotation engineer. It is the function of the department to co-operate with the mining and metallurgical fraternity in any way consistent with an established and conservative manufacturing and selling policy. This department will be glad to discuss the flotation-oil problems of the individual operators and it invites correspondence along these lines at all times. All such inquiries will receive careful consideration and will be discussed in a conservative technical manner.

The New Jersey Concentrating Co. in order to cope with increasing business and to offer greater facilities to its clients, has acquired spacious water-front property in Elizabethport, New Jersey. The company is ready to grind, concentrate, separate, and store all kinds of metals and minerals, such as manganese, chrome, etc. A 300-ft. private dock allows vessels to berth right alongside the plant. Railroad-siding along the whole length of the dock affords unloading from steamer into cars for bulk shipments. Additional railroad siding allows the simultaneous handling of 15 to 20 cars. Crushers, rolls, and sampling floors afford correct and expeditious sampling while loading or unloading steamers or cars.

BARBER-GREENE BUCKET-LOADER

The accompanying illustration shows a bucket-loader manufactured by the Barber-Greene Co., of Aurora, Illinois.

Barber-Greene machines are standardized. They do not undergo much change from year to year, although the experimental department is continually after refinements. The newest self-feeding bucket-loader has the revolving-disc feeder which distinguishes all B-G loaders. The crawler type of traction has been adopted as standard. Crawlers make it possible to turn a machine around in its own length, one crawler can be stopped while all the power is given to the other to furnish the turning force. Of course, crawlers permit a machine to be operated on soft ground where a machine on wheels could not 'navigate'. Continuous treads, 58 by 8 in., make a bearing pressure of only seven pounds per square inch on the ground. No change has been made in the power-units used to drive the machine. The four-



Bucket-Loader

cylinder truck-type 'Buda' gasoline engine is used as before. It possesses ample power for every operating possibility.

A somewhat radical departure from the general Barber-Greene design of standardized conveyors has been made in the new universal conveyor recently put on the market. Type 'U', instead of having trussed sectional construction, has a channel frame 4 in. by 22 ft. Twenty-two feet has been adopted as the only length, since this machine is designed only for unloading cars and loading wagons or trucks and other jobs where length and height of discharge are not needed. This is called the conveyor with the digging end because of the new method of belt and hopper construction. The lower end of the machine is built with belt exposed. Cupped flights across the belt furnish the digging parts, so that the machine may be pushed into a pile of loose material where it will burrow its way under as long as the pushing is kept up. The standard belt width is 12 in., and every inch is made available by overlapping steel side-plates attached on the edges of the belt. They form a trough as wide as the belt, and prevent any wear on the belt edges. Skirt-boards the full length of the machine, set at an angle, make it possible to carry lumps much larger than twelve inches.